

# WELCOME TO THE KERN HEALTH SYSTEMS

## Hypertension Management Guidelines Presentation

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*Guest Speaker: Atul Aggarwal MD, FACC, FAHA, FSCAI*



# Outlay

- Definition of High Blood Pressure
- Blood Pressure and CVD risk factors
- Measurement of Blood Pressure
- Causes of hypertension (Secondary hypertension)
- Treatment for High Blood Pressure
  - Thresholds, Goals, Follow up, Drug therapy
- Resistant hypertension
- Nonpharmacological interventions
- Special considerations and groups



# Case Vignette

A 50-yr-old man presents to your office for second opinion regarding management of hypertension. He had seen his internist for routine physical 1 month prior and reports that his BP was "high" & his internist recommended that he "start some pills," which patient prefers to avoid. He denies any symptoms. Has no medical problems and takes only a daily multivitamin, does not exercise regularly & does not smoke cigarettes.

On exam, he is 5'10" tall and weighs 200 lbs with BMI 28.7 kg/m<sup>2</sup>. His heart rate is 88 bpm and BP is 154/92 mm Hg. Lungs are clear and heart is regular with no murmurs or gallops. Abdomen is soft without bruits. Extremities are warm without edema.

Labs show Na 140 mmol/L, K 4.0 mEq/L, and creatinine 0.8 mg/dL. Fasting lipid profile shows cholesterol 200, HDL 50, LDL 130, and triglycerides 100. His 10-yr risk of atherosclerotic cardiovascular disease (ASCVD) calculated by the ASCVD pooled cohort risk assessment equations is 4.8%.

# Case Vignette

In addition to recommending DASH (Dietary Approaches to Stop Hypertension) diet and daily exercise, what is best next step?

1. Start Lisinopril 10 mg & Chlorthalidone 12.5 mg daily
2. Start Metoprolol ER 50 mg & Chlorthalidone 12.5 mg daily
3. Start Chlorthalidone 25 mg daily
4. Reassess BP in 3 months
5. Start amlodipine 10 mg daily

Stage 2 hypertension merits nonpharmacological therapy (DASH diet, weight loss, exercise, avoidance of alcohol) along with medication (Class I recommendation) with reassessment in 1 month to determine whether BP goal has been met.

Initiation of antihypertensive drug therapy with two first-line agents of different classes, either as separate agents or fixed-dose combination, is recommended in adults with stage 2 hypertension or an average BP  $>20/10$  mm Hg above their BP target.

Beta-blockers are not recommended as first-line agents for BP management unless patient has ischemic heart disease or heart failure.

Patients with normal BP,  $<120/80$  mm Hg, require only promotion of optimal lifestyle habits and can be re-evaluated in 1 year. Re-evaluation in 3 months is not correct for this man with stage 2 hypertension.

**2017 ACC/AHA/AAPA/ABC/ACPM/AGS/  
APhA/ASH/ASPC/NMA/PCNA  
Guideline for the Prevention, Detection,  
Evaluation, and Management of High Blood  
Pressure in Adults**

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# Definition of High BP

<b>COR</b>	<b>LOE</b>	<b>Recommendation for Definition of High BP</b>
<b>I</b>	<b>B-NR</b>	BP should be categorized as normal, elevated, or stage 1 or 2 hypertension to prevent and treat high BP

# 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
<b>Hypertension</b>			
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 based on an average of ≥2 careful readings obtained on ≥2 occasions)*



# Prevalence of Hypertension Based on 2 SBP/DBP Thresholds\*†

	SBP/DBP $\geq$ 130/80 mm Hg or Self-Reported Antihypertensive Medication†		SBP/DBP $\geq$ 140/90 mm Hg or Self-Reported Antihypertensive Medication‡	
<b>Overall, crude</b>	46%		32%	
	Men (n=4717)	Women (n=4906)	Men (n=4717)	Women (n=4906)
<b>Overall, age-sex adjusted</b>	48%	43%	31%	32%
<b>Age group, y</b>				
<b>20–44</b>	30%	19%	11%	10%
<b>45–54</b>	50%	44%	33%	27%
<b>55–64</b>	70%	63%	53%	52%
<b>65–74</b>	77%	75%	64%	63%
<b>75+</b>	79%	85%	71%	78%
<b>Race-ethnicity §</b>				
<b>Non-Hispanic White</b>	47%	41%	31%	30%
<b>Non-Hispanic Black</b>	59%	56%	42%	46%
<b>Non-Hispanic Asian</b>	45%	36%	29%	27%
<b>Hispanic</b>	44%	42%	27%	32%

\*130/80 and 140/90 mm Hg in 9623 participants ( $\geq$ 20 y of age) in NHANES 2011–2014

†BP cutpoints for definition of hypertension in the present guideline.

‡BP cutpoints for definition of hypertension in JNC 7.

§ Adjusted to the 2010 age-sex distribution of the U.S. adult population

# Case Vignette

A healthy, postmenopausal 53-yr-old woman presents for evaluation of elevated blood pressure. At her most recent primary care visit, her blood pressure was 138/88 mm Hg. At the time of presentation to you today, her blood pressure is 132/80 mm Hg. The patient wants to know if she has hypertension.



# Case Vignette

Which of the following best describes her blood pressure?

1. Stage II hypertension is present
2. Prehypertension is present
3. There are inadequate BP readings for a diagnosis
4. BP is normal for her age
5. Stage I hypertension is present



# 2017 Hypertension Clinical Practice Guidelines

## **BP and CVD Risk**

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# Coexistence of Hypertension and Related Chronic Conditions

<b>COR</b>	<b>LOE</b>	<b>Recommendation for Coexistence of Hypertension and Related Chronic Conditions</b>
<b>I</b>	<b>B-NR</b>	Screening for and management of other modifiable CVD risk factors are recommended in adults with hypertension

# CVD Risk Factors Common in Patients With Hypertension

<b>Modifiable Risk Factors*</b>	<b>Relatively Fixed Risk Factors†</b>
<ul style="list-style-type: none"><li>● Current cigarette smoking, secondhand smoking</li><li>● Diabetes mellitus</li><li>● Dyslipidemia</li><li>● Overweight/obesity</li><li>● Physical-inactivity/low fitness</li><li>● Unhealthy diet</li></ul>	<ul style="list-style-type: none"><li>● CKD</li><li>● Family history</li><li>● Increased age</li><li>● Low socioeconomic status</li><li>● Male sex</li><li>● Obstructive sleep apnea</li><li>● Psychosocial stress</li></ul>

# 2017 Hypertension Guideline

## Measurement of BP

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# Out-of-Office and Self-Monitoring of BP

COR	LOE	Recommendation for Out-of-Office and Self-Monitoring of BP
I	A	Out-of-office BP measurements recommended to <u>confirm diagnosis</u> of hypertension and for <u>titration of BP-lowering medication</u> , in conjunction with telehealth counseling or clinical interventions.



# Masked and White Coat Hypertension

<b>COR</b>	<b>LOE</b>	<b>Recommendations for Masked and White Coat Hypertension</b>
<b>IIa</b>	<b>B-NR</b>	Untreated SBP >130 mm Hg but <160 mm Hg or DBP >80 mm Hg but <100 mm Hg, reasonable to screen for white coat hypertension by using daytime ABPM or HBPM before diagnosis of hypertension

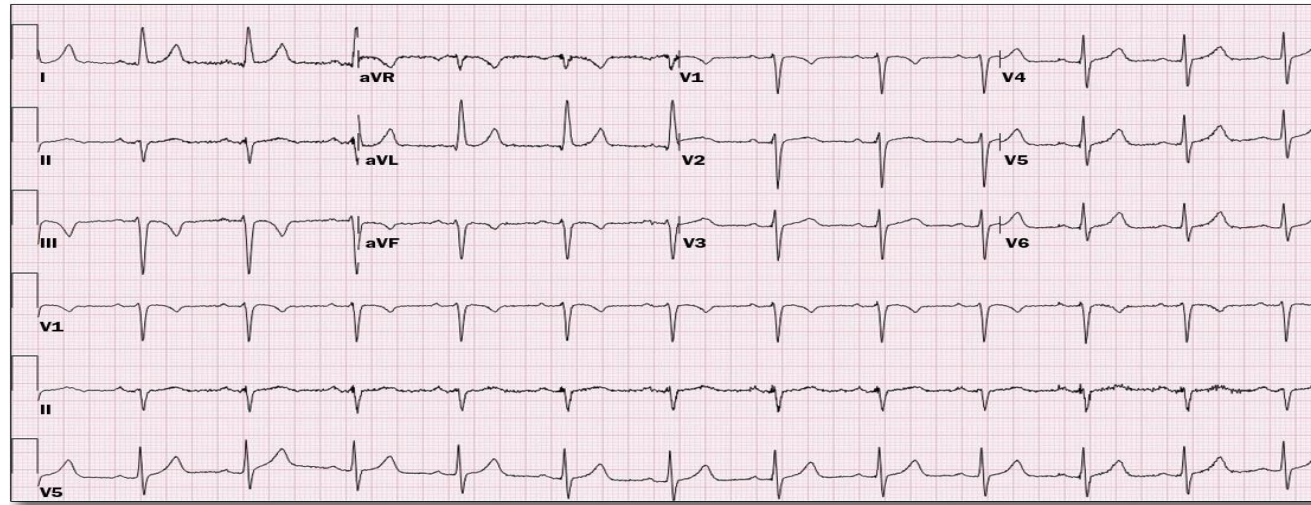
# BP Patterns Based on Office and Out-of-Office Measurements

	<b>Office/Clinic/Healthcare Setting</b>	<b>Home/Nonhealthcare/ABPM Setting</b>
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.*

# Case Vignette

A 47-yr-old woman is referred to your office for abnormal ECG. She has history of obesity and pre-eclampsia when she was pregnant with twins. She is on no medications. On exam, her BMI is 31 kg/m<sup>2</sup>, heart rate 80 bpm, and BP 128/72 mm Hg. Her physical examination is unremarkable.



# Case Vignette

In addition to lifestyle counseling, which of following is best next step in this patient's care?

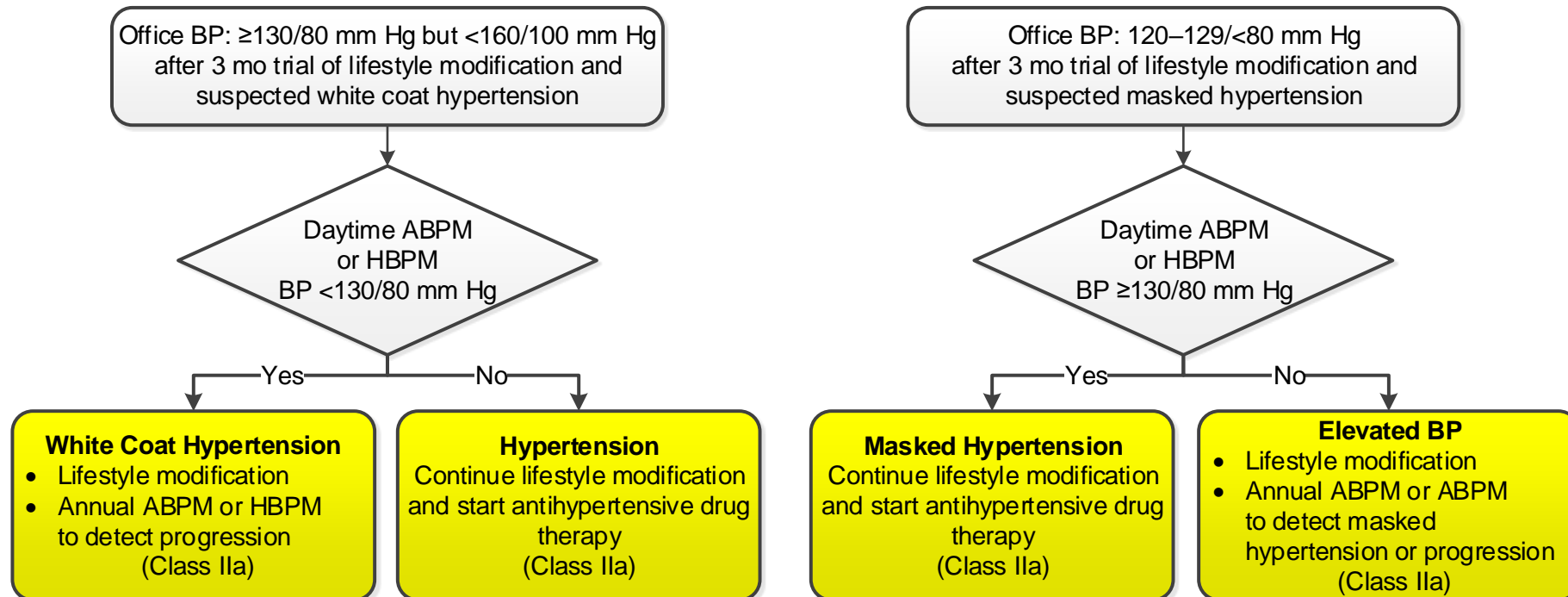
1. 24-hr Holter
2. 24-hr ambulatory BP monitor or home BP log
3. Exercise treadmill stress test
4. TSH
5. 24-hr urine protein



- ECG shows LVH, but her office BP is not high, suggesting **masked hypertension**. Masked hypertension noted in 10-40%. Thus, 24-hr ambulatory or home BP monitor is needed to diagnose masked hypertension
- Pre-eclampsia puts her at higher risk for hypertension later in life.
- She is asymptomatic from CV standpoint; thus, Holter or exercise testing are not warranted
- TSH & UA may be helpful later; first step is ambulatory or home BP monitor
- If spot urinalysis is abnormal, 24-hr



# Detection of White Coat Hypertension or Masked Hypertension in Patients Not on Drug Therapy



# 2017 Hypertension Guideline

## Causes of Hypertension

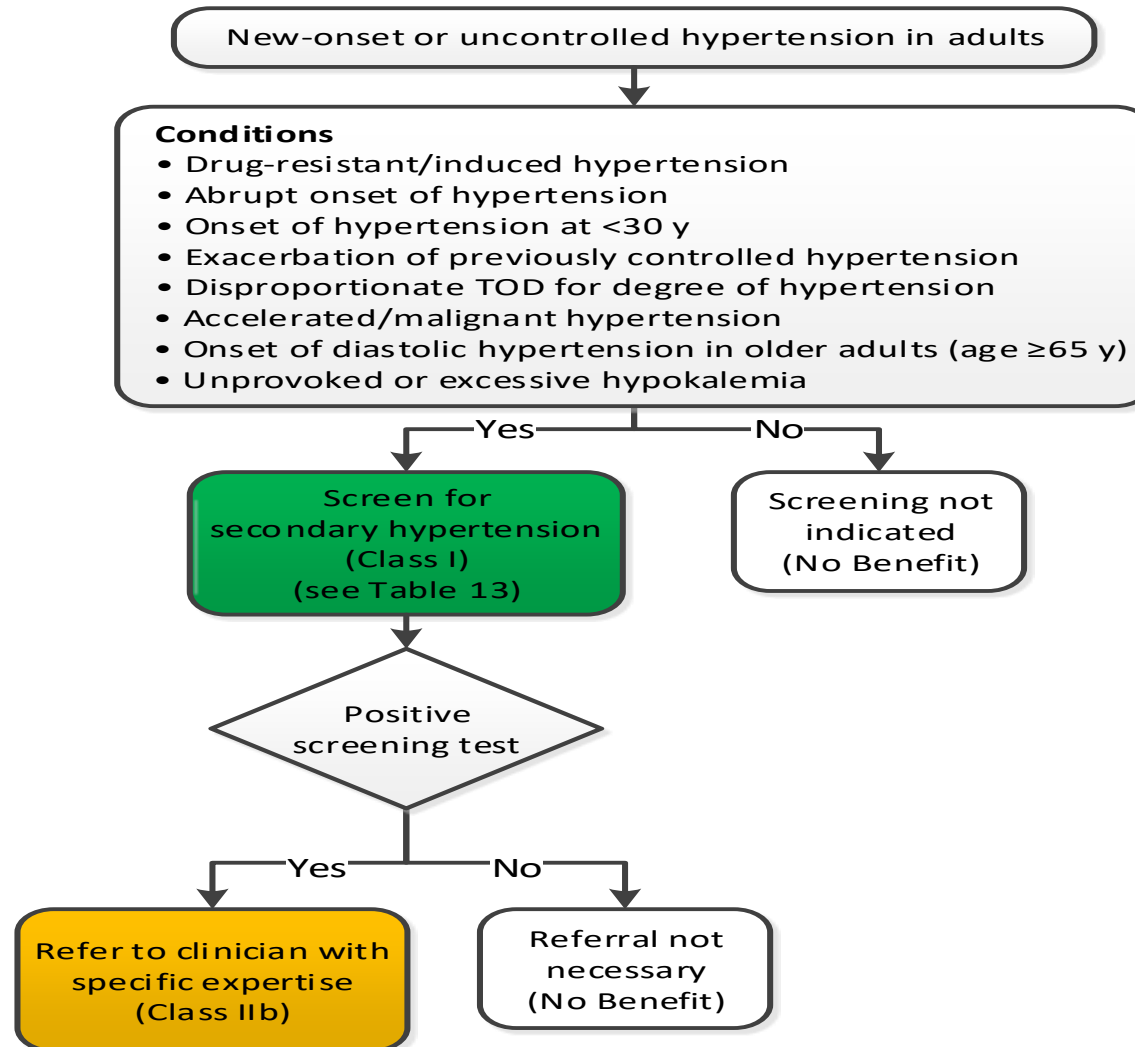


# Secondary Forms of Hypertension

<b>COR</b>	<b>LOE</b>	<b>Recommendations for Secondary Hypertension</b>
<b>I</b>	<b>C-EO</b>	Screening for specific secondary hypertension recommended when clinical & physical exam findings present or with resistant hypertension
<b>I<b>b</b></b>	<b>C-EO</b>	If adult screens positive for secondary hypertension, referral to physician with expertise in hypertension reasonable for confirmation & treatment



# Screening for Secondary Hypertension



# Causes of Secondary Hypertension With Clinical Indications

<b>Common causes</b>
Renal parenchymal disease
Renovascular disease
Primary aldosteronism
Obstructive sleep apnea
Drug or alcohol induced
<b>Uncommon causes</b>
Pheochromocytoma/paraganglioma
Cushing's syndrome
Hypothyroidism
Hyperthyroidism
Aortic coarctation (undiagnosed or repaired)
Primary hyperparathyroidism
Congenital adrenal hyperplasia
Mineralocorticoid excess syndromes other than primary aldosteronism
Acromegaly

# Renal Artery Stenosis

<b>COR</b>	<b>LOE</b>	<b>Recommendations for Renal Artery Stenosis</b>
<b>I</b>	<b>A</b>	Medical therapy is recommended for adults with atherosclerotic renal artery stenosis
<b>IIb</b>	<b>C-EO</b>	In renal artery stenosis where, medical management has failed (refractory hypertension, worsening renal function, or intractable HF) and those with fibromuscular dysplasia, it is reasonable to refer patient for revascularization (percutaneous renal artery angioplasty and/or stent placement)

# 2017 Hypertension Guideline

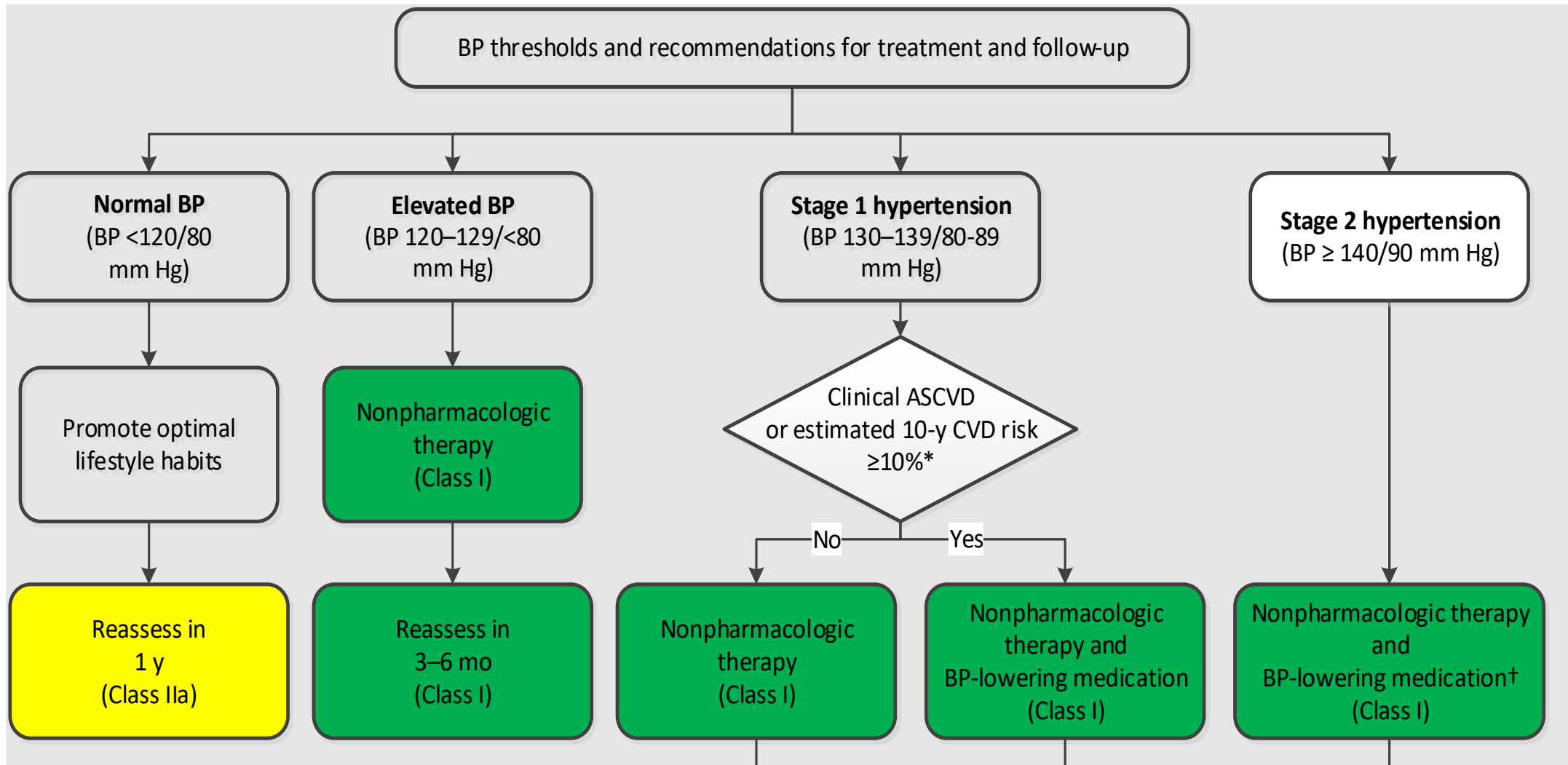
## Treatment of High BP



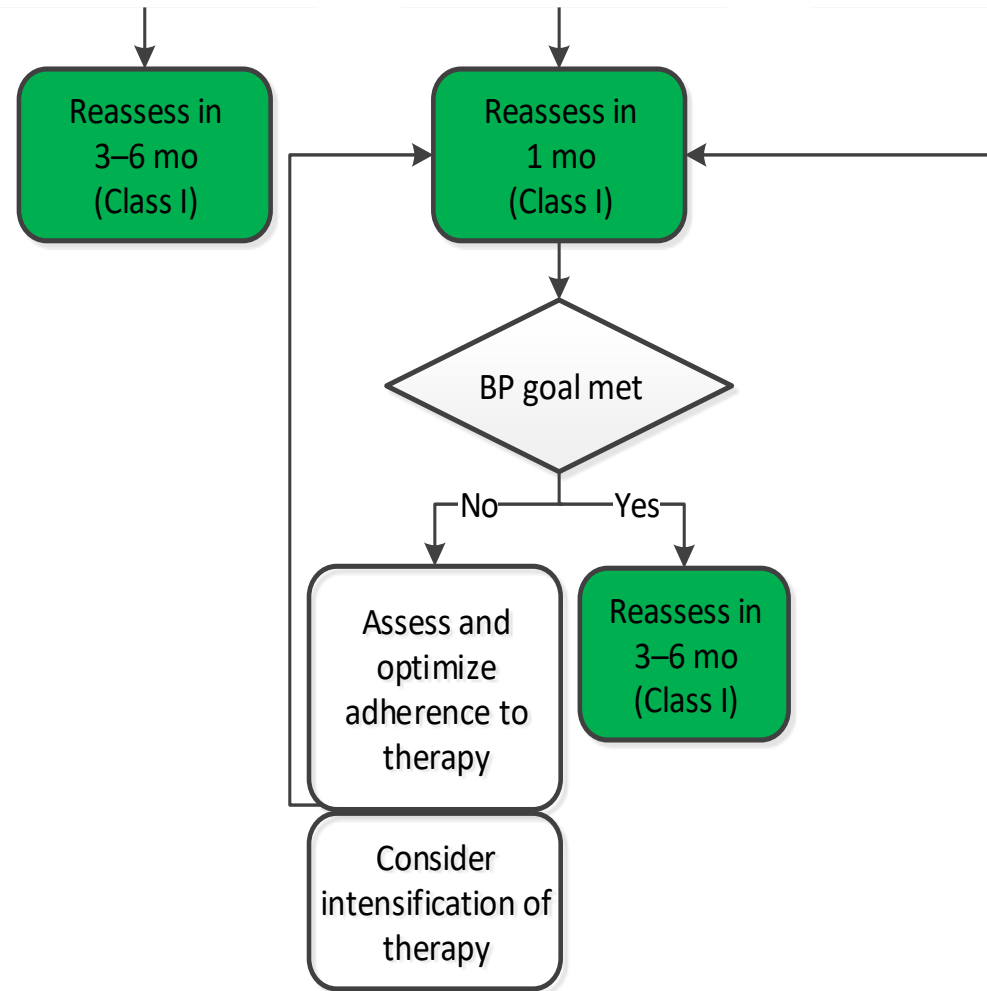
# BP Treatment Threshold and the Use of CVD Risk Estimation to Guide Drug Treatment of Hypertension

<b>COR</b>	<b>LOE</b>	<b>Recommendations for BP Treatment Threshold and Use of Risk Estimation* to Guide Drug Treatment of Hypertension</b>
<b>I</b>	<b>SBP: A</b>	BP-lowering medications recommended for secondary prevention with clinical CVD and SBP $\geq$ 130 mm Hg or DBP $\geq$ 80 mm Hg, and for primary prevention with estimated 10-year ASCVD risk of $\geq$ 10% and SBP $\geq$ 130 mm Hg or DBP $\geq$ 80 mm Hg
	<b>DBP: C-EO</b>	
<b>I</b>	<b>C-LD</b>	BP-lowering medication recommended for primary prevention of CVD with 10-year ASCVD risk $<$ 10% and SBP $\geq$ 140 mm Hg or DBP $\geq$ 90 mm Hg

# Blood Pressure Thresholds and Recommendations for Treatment and Follow-Up



# Blood Pressure Thresholds and Recommendations for Treatment and Follow-Up



# Basic and Optional Laboratory Tests for Primary Hypertension

<b>Basic testing</b>	<ul style="list-style-type: none"><li>• Fasting blood glucose</li><li>• Complete blood count</li><li>• Lipid profile</li><li>• Serum creatinine with eGFR</li><li>• Serum sodium, potassium, calcium</li><li>• Thyroid-stimulating hormone</li><li>• Urinalysis</li><li>• Electrocardiogram</li></ul>
<b>Optional testing</b>	<ul style="list-style-type: none"><li>• Echocardiogram</li><li>• Uric acid</li><li>• Urinary albumin to creatinine ratio</li></ul>

Whelton PK, et al. *J Am Coll Cardiol* 2017.



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# Follow-Up After Initial BP Evaluation

<b>COR</b>	<b>LOE</b>	<b>Recommendations for Follow-Up After Initial BP Elevation</b>
<b>I</b>	<b>B-R</b>	Elevated BP or stage 1 hypertension with 10-yr ASCVD risk <10% - nonpharmacological therapy; Repeat evaluation within 3 - 6 months
<b>I</b>	<b>B-R</b>	Stage 1 hypertension with 10-year ASCVD risk >10% - nonpharmacological and antihypertensive drug therapy, Repeat BP evaluation in 1 month
<b>I</b>	<b>B-R</b>	Stage 2 hypertension should be evaluated by or referred to PCP within 1 month of initial diagnosis, have nonpharmacological and antihypertensive drug therapy (with 2 agents of different classes); Repeat BP evaluation in 1 month

# Follow-Up After Initial BP Evaluation

<b>COR</b>	<b>LOE</b>	<b>Recommendations for Follow-Up After Initial BP Elevation</b>
<b>I</b>	<b>B-R</b>	Very high average BP (e.g., SBP $\geq$ 180 mm Hg or DBP $\geq$ 110 mm Hg), evaluation followed by prompt antihypertensive drug treatment recommended
<b>IIa</b>	<b>C-EO</b>	For adults with normal BP, repeat evaluation every year is reasonable

# BP Goal for Patients With Hypertension

COR	LOE	Recommendations for BP Goal for Patients With Hypertension
I	SBP: B-R	For adults with confirmed hypertension and known CVD or 10-year ASCVD event risk $\geq 10\%$ , BP target <130/80 mm Hg is recommended
	DBP: C-EO	
IIb	SBP: B-NR	For adults with confirmed hypertension, without additional markers of increased CVD risk, BP target <130/80 mm Hg may be reasonable
	DBP: C-EO	

# Choice of Initial Medication

<b>COR</b>	<b>LOE</b>	<b>Recommendation for Choice of Initial Medication</b>
<b>I</b>	<b>A<sup>SR</sup></b>	For initiation of antihypertensive drug therapy, first-line agents include thiazide diuretics, CCBs, and ACE inhibitors or ARBs

# General Principles of Drug Therapy

<b>COR</b>	<b>LOE</b>	<b>Recommendation for General Principle of Drug Therapy</b>
<b>III: Harm</b>	<b>A</b>	Simultaneous use of an ACE inhibitor, ARB, and/or renin inhibitor is potentially harmful and is not recommended

## Choice of Initial Monotherapy Versus Initial Combination Drug Therapy

<b>COR</b>	<b>LOE</b>	<b>Recommendations for Choice of Initial Monotherapy Versus Initial Combination Drug Therapy*</b>
<b>I</b>	<b>C-EO</b>	Initiation of antihypertensive drug therapy with 2 first-line agents of different classes, is recommended with stage 2 hypertension and BP more than 20/10 mm Hg above their BP target
<b>IIa</b>	<b>C-EO</b>	Initiation of antihypertensive drug therapy with single antihypertensive drug is reasonable in adults with stage 1 hypertension and BP goal <130/80 mm Hg with dosage titration and sequential addition of other agents to achieve the BP target

# Case Vignette

- A 39-year-old African American man is referred to your clinic for poorly controlled hypertension. His BP on ambulatory readings is 150/90 mm Hg. He takes hydrochlorothiazide 25 mg once a day.
- Exam show temperature 98.9°F, BP 149/95 mm Hg, and heart rate 90 bpm. Normal S1 and S2 with soft systolic murmur.
- His laboratory data show sodium 135 mg/dL, potassium 3.9 mg/dL, and creatinine 1.1
- In addition to lifestyle modification, what is your best next step?



# Case Vignette

1. Switch to Spironolactone 25 mg daily
2. Add Amlodipine 10 mg daily
3. Increase Hydrochlorothiazide to 50 mg daily
4. Start Lisinopril 20 mg daily
5. Start Isosorbide 20 mg plus Hydralazine 25 mg three times daily





- Patient has BP above goal and requires additional antihypertensive therapy
- In **African Americans, thiazides or CCBs are more effective** in lowering BP than RAS inhibitors or  $\beta$  blockers
- **Combination therapy** is often associated with fewer side effects compared with single agent. Increasing hydrochlorothiazide to 50 mg daily would likely not be best option
- Isosorbide/hydralazine combination therapy is adjunctive therapy for heart failure in



# Follow-Up After Initiating Antihypertensive Drug Therapy

<b>COR</b>	<b>LOE</b>	<b>Recommendation for Follow-Up After Initiating Antihypertensive Drug Therapy</b>
<b>I</b>	<b>B-R</b>	Adults initiating new or adjusted drug regimen for hypertension should have follow-up evaluation of adherence and response to treatment at <u>monthly</u> intervals until control is achieved

# Monitoring Strategies to Improve Control of BP in Patients on Drug Therapy for High BP

<b>COR</b>	<b>LOE</b>	<b>Recommendation for Monitoring Strategies to Improve Control of BP in Patients on Drug Therapy for High BP</b>
<b>I</b>	<b>A</b>	Follow-up and monitoring after initiation of drug therapy for hypertension control should include systematic strategies to help improve BP - use of HBPM, team-based care and telehealth strategies

# Case Vignette

- A 56-yr-old man with CAD, post RCA stenting 3 years prior, hypertension, type II DM, and hyperlipidemia comes for annual follow-up. He is asymptomatic.
- His BP is 130/91 mm Hg with heart rate of 72 bpm. His height is 5' 8 " and weight 218 lbs. He is euvolemic with soft S4 gallop and no murmurs. There is no peripheral edema
- EKG - sinus rhythm with LVH. Echo 1 yr. prior - preserved ejection fraction, LVH
- Lab values - potassium 4.0 mmol/L, Cr 1.2 mg/dL, total cholesterol 170 mg/dL, low-density LDL 64 mg/dL, and HbA1c 6.2%. Urinalysis reveals microalbuminuria
- Medications - rosuvastatin 40 mg, aspirin 81 mg, and metoprolol succinate 50 mg
- Lisinopril 10 mg daily is started. He returns 1 week later, and his BP is 122/78 mm Hg. Repeat lab values show potassium 4.4 mmol/L and Cr 1.5 mg/dL

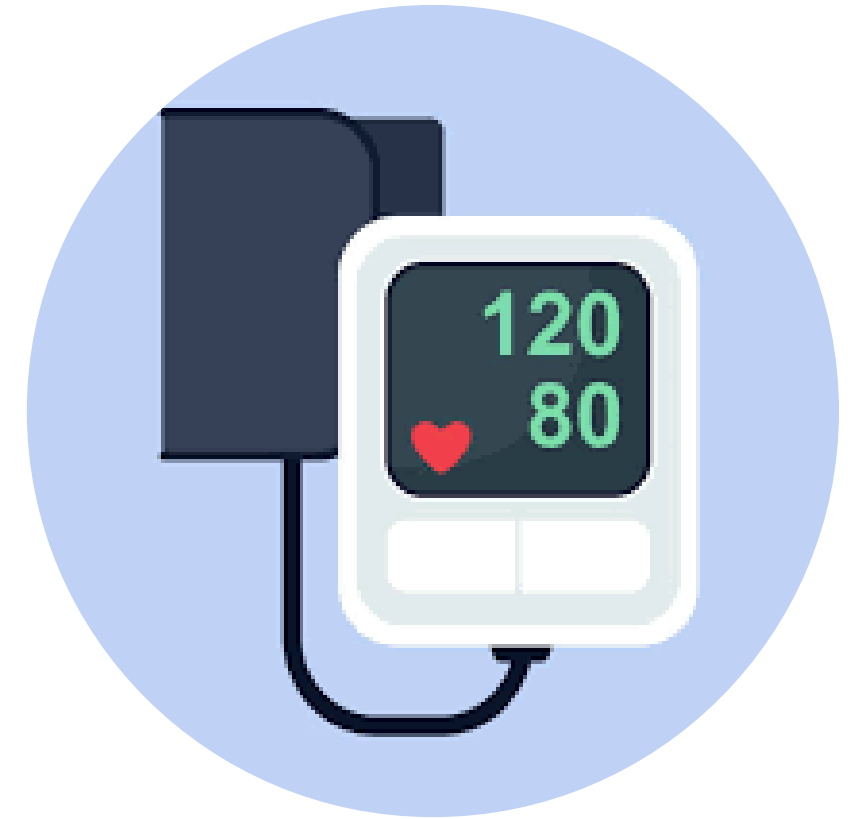
# Case Vignette

What is the best next step in his care?

1. Reduce Lisinopril to 5 mg daily
2. Stop Lisinopril. Add amlodipine 5 mg daily
3. Continue current treatment
4. Add Spironolactone 12.5 mg daily
5. Add Sacubitril/ Valsartan



- Patient has diabetes mellitus with renal insufficiency and microalbuminuria for which ACEI/ ARB is indicated to treat hypertension and slow renal dysfunction. Expected effect of addition of ACEI/ARB is rise in serum Cr of  $\leq 30\%$ . This is not an indication to change dose or stop lisinopril
- Patient does not have resistant hypertension or heart failure, and his BP is reasonably controlled. Addition of spironolactone is incorrect
- Sacubitril/valsartan is used with reduced ejection fraction, which this patient does not have



# Resistant Hypertension



# Case Vignette

- A 53-yr-old woman with history of hypertension, osteoporosis, and obesity comes for follow-up. Complains of fatigue & occasional ankle swelling during hot weather. She denies headaches, visual changes, shortness of breath or chest pain
- Daily meds - amlodipine 10 mg, hydrochlorothiazide 25 mg, lisinopril 40 mg, pravastatin 20 mg, and CaCO<sub>3</sub> 600 mg
- Her heart rate is 68 bpm, BP is 149/93 mm Hg, and BMI is 34.5 kg/m<sup>2</sup>. Cardiac exam - normal S1,S2 without murmurs. Lungs are clear. Abdomen is obese without bruits. Extremities have 2+ posterior tibial pulses and without edema
- Lab values - normal renal function and electrolytes



# Case Vignette

Which of the following is the best next step in her care?

1. Add spironolactone 12.5 mg daily
2. Increase hydrochlorothiazide to 50 mg daily
3. Change lisinopril to losartan 100 mg daily
4. Add metoprolol 100 mg daily
5. Stop supplemental calcium



# Case Vignette

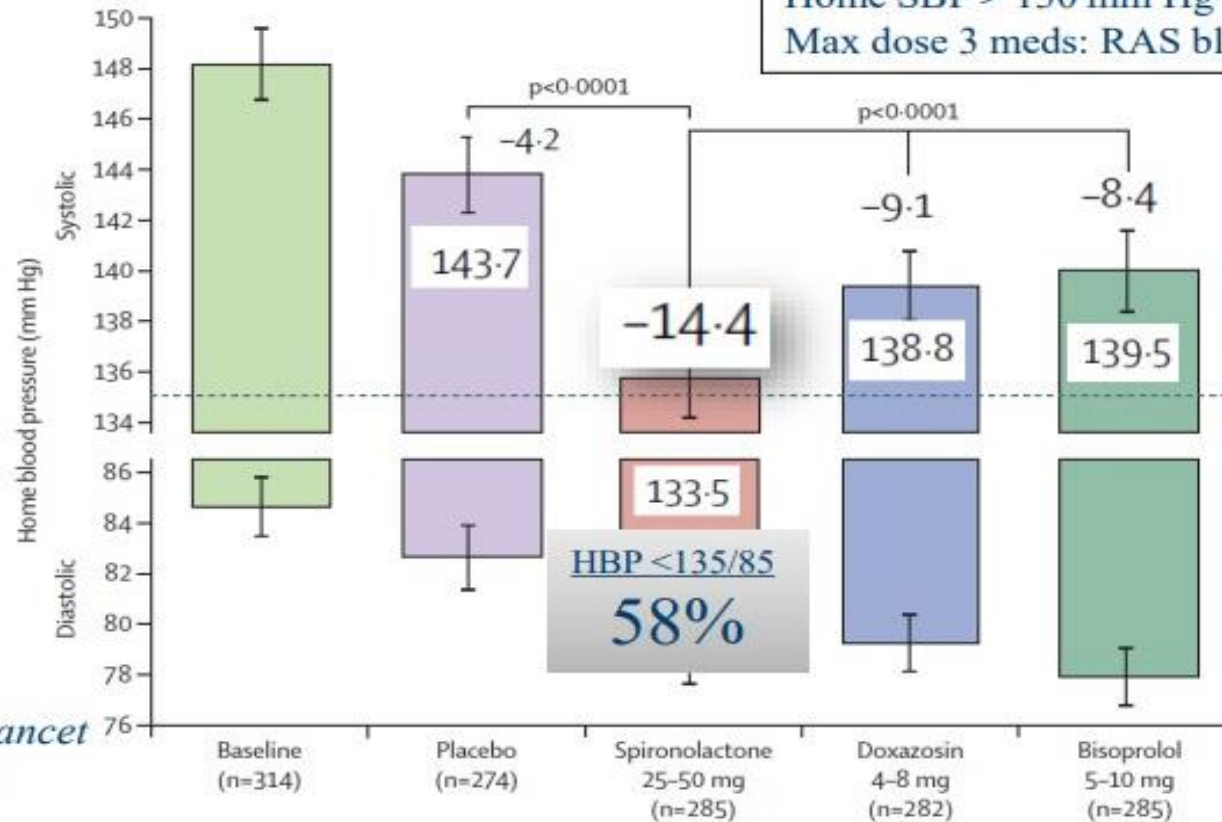
- In this patient on full doses of 3 different agents incl. diuretic, addition of spironolactone or eplerenone as add-on therapy reduces systolic blood pressure by ~24 mm Hg at 6 months
- Beta-blockers (metoprolol succinate) are not effective antihypertensive meds and therefore would not be expected to have significant impact on resistant hypertension
- Changing lisinopril to losartan is indicated for pts with cough attributed to ACE inhibitors, but would not provide better BP control
- With normal renal function, there is little added benefit in increasing hydrochlorothiazide beyond 25 mg daily
- Calcium supplements do not cause secondary hypertension and given her osteoporosis, she should continue this

# PATHWAY-2

Spironolactone versus placebo, bisoprolol, and doxazosin to determine the optimal treatment for drug-resistant hypertension (PATHWAY-2): A randomized, double-blind crossover trial

## “RESISTANT HTN” PATIENTS:

Home SBP > 130 mm Hg (HBP = 147/84; clinic 157/90)  
Max dose 3 meds: RAS blocker + CCB + Diuretic



## SPIRO

“Most effective”  
3x control rate of others  
Better at all PRA levels  
Better dose-response

## SPIRO

Home SBP > 150  
5%

Williams B et al. *Lancet*  
2015;386;2059-68.



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### **Confirm Treatment Resistance**

Office SBP/DBP  $\geq$ 130/80 mm Hg  
and  
Patient prescribed  $\geq$ 3 antihypertensive medications at optimal doses, including a diuretic, if possible  
or  
Office SBP/DBP <130/80 mm Hg but patient requires  $\geq$ 4 antihypertensive medications

### **Exclude Pseudoresistance**

Ensure accurate office BP measurements  
Assess for nonadherence with prescribed regimen  
Obtain home, work, or ambulatory BP readings to exclude white coat effect

### **Identify and Reverse Contributing Lifestyle Factors**

Obesity  
Physical inactivity  
Excessive alcohol ingestion  
High-salt, low-fiber diet

### **Discontinue or Minimize Interfering Substances**

NSAIDs  
Sympathomimetic (e.g., amphetamines, decongestants)  
Stimulants  
Oral contraceptives  
Licorice  
Ephedra

### **Screen for Secondary Causes of Hypertension**

Primary aldosteronism (elevated aldosterone/renin ratio)  
CKD (eGFR <60 mL/min/1.73 m<sup>2</sup>)  
Renal artery stenosis (young female, known atherosclerotic disease, worsening kidney function)  
Pheochromocytoma (episodic hypertension, palpitations, diaphoresis, headache)  
Obstructive sleep apnea (snoring, witnessed apnea, excessive daytime sleepiness)

### **Pharmacological Treatment**

Maximize diuretic therapy  
Add a mineralocorticoid receptor antagonist  
Add other agents with different mechanisms of actions  
Use loop diuretics in patients with CKD  
and/or patients receiving potent vasodilators (e.g., minoxidil)

### **Refer to a Specialist**

Refer to appropriate specialist for known or suspected secondary cause(s) of hypertension  
Refer to hypertension specialist if BP remains uncontrolled after 6 months of treatment

# Resistant hypertension

- A 46-year-old man is referred to your clinic for resistant hypertension. He feels well but notes occasional lightheadedness. He leads active lifestyle and denies chest pain or shortness of breath
- Medications - amlodipine 10 mg daily, carvedilol 12.5 mg twice a day, chlorthalidone 12.5 mg daily, and lisinopril 40 mg daily
- Examination - pulse 58 bpm and BP 156/94 mm Hg on right and 152/90 mm Hg on left. BMI is 27 kg/m<sup>2</sup>. Cardiac exam- normal S1S2 sound with no murmurs. Lungs are clear. Abdomen is soft without organomegaly or bruits. 2+ pulses in upper and lower extremities
- ECG - sinus bradycardia. Echo - normal biventricular size and function, no ventricular hypertrophy or significant valve disease. Basic metabolic panel is normal

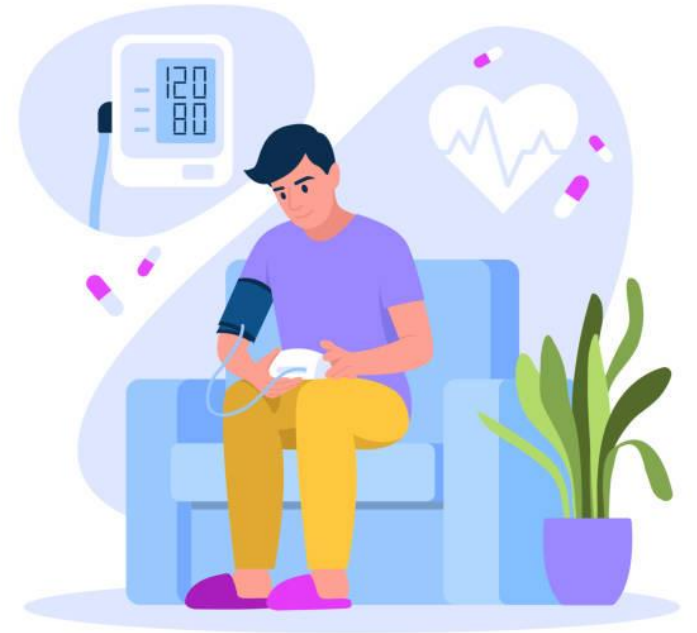
# Resistant hypertension

In addition to reinforcing lifestyle modifications, which of following is best next step in management of this patient?

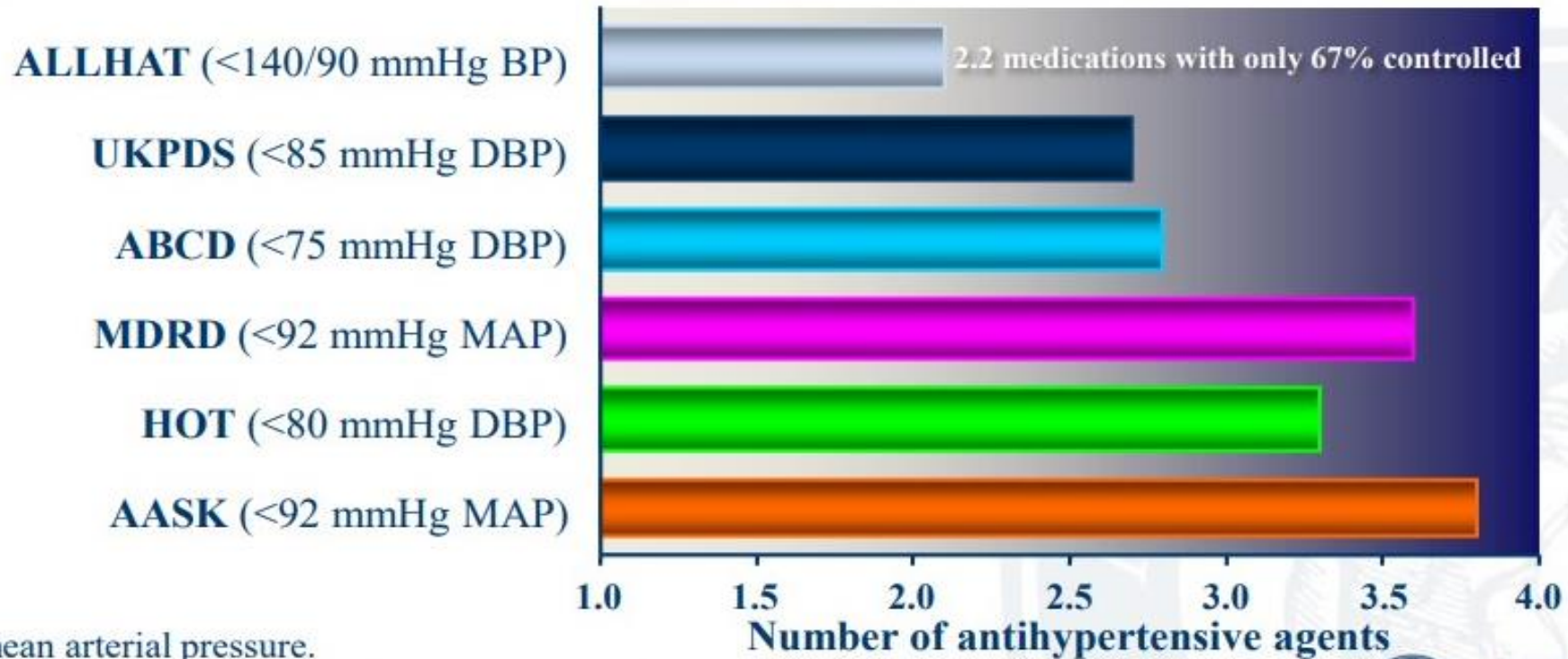
1. Exercise treadmill stress test
2. Carotid Duplex
3. Chest CT
4. Low potassium diet
5. Home BP monitoring



- Resistant hypertension is persistently elevated BPs despite three-drug regimen of different classes, one of which should be diuretic. Given this patient's lightheadedness and lack of LVH on echocardiogram or ECG, it is unclear whether his elevated office BPs are reflective of his home BPs. Additional information such as 24-hour BP or home BP monitoring to exclude pseudo-resistant hypertension is indicated. An ambulatory or home BP monitor will yield more accurate representation of his BP
- CT angiography can be used to evaluate for aortic coarctation, which is rare cause of secondary hypertension. In this patient, his symmetric BP, lack of LVH, and lack of pressure gradient in descending aorta on echo make this unlikely diagnosis
- Nonpharmacologic interventions to reduce BP include diet rich in high-potassium foods; therefore, low-potassium diet is incorrect
- Exercise treadmill stress test is not indicated in this asymptomatic patient
- Patient has no transient ischemic attack or stroke-like symptoms to suggest cerebral vascular disease; therefore, a carotid duplex is not indicated



# Average Number of Antihypertensive Agents Needed to Achieve BP Goals = 3.2



MAP, mean arterial pressure.

Bakris GL et al. *Am J Kidney Dis* 2000;36:646-661.

Cushman WC et al. *J Clin Hypertens* 2002;4:393-404.



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# Oral Antihypertensive Drugs

Class	Drug	Usual Dose Range (mg/d)	Daily Freq	Comments
<b>Primary agents</b>				
<b>Thiazide or thiazide-type diuretics</b>	<b>Chlorthalidone</b>	12.5-25	1	<ul style="list-style-type: none"> <li>• Chlorthalidone preferred based on prolonged half-life and proven trial reduction of CVD</li> <li>• Monitor for hyponatremia and hypokalemia, uric acid and calcium levels</li> <li>• Use with caution in patients with history of acute gout unless patient is on uric acid-lowering therapy</li> </ul>
	<b>Hydrochlorothiazide</b>	25-50	1	
	<b>Indapamide</b>	1.25-2.5	1	
	<b>Metolazone</b>	2.5-10	1	

Whelton PK, et al. *J Am Coll Cardiol* 2017.



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# Oral Antihypertensive Drugs

Class	Drug	Usual Dose Range (mg/d)	Daily Freq	Comments
<b>Primary agents</b>				
<b>ACE Inhibitors</b>	Benazepril	10-40	1 or 2	<ul style="list-style-type: none"> <li>• Do not use in combination with ARBs or direct renin inhibitor</li> <li>• Increased risk of hyperkalemia, especially in patients with CKD or in those on K<sup>+</sup> supplements or K<sup>+</sup> sparing drugs</li> <li>• May cause acute renal failure in patients with severe bilateral renal artery stenosis</li> <li>• Do not use if history of angioedema with ACE inhibitors</li> <li>• Avoid in pregnancy</li> </ul>
	Captopril	12.5-150	2 or 3	
	Enalapril	5-40	1 or 2	
	Fosinopril	10-40	1	
	Lisinopril	10-40	1	
	Moexipril	7.5-30	1 or 2	
	Perindopril	4-16	1	
	Quinapril	10-80	1 or 2	
	Ramipril	2.5-10	1 or 2	
	Trandolapril	1-4	1	

Whelton PK, et al. *J Am Coll Cardiol* 2017.



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# Oral Antihypertensive Drugs

Class	Drug	Usual Dose Range (mg/d)	Daily Freq	Comments
<b>Primary agents</b>				
<b>ARBs</b>	Azilsartan	40-80	1	<ul style="list-style-type: none"> <li>• Do not use in combination with ACE inhibitors or direct renin inhibitor</li> <li>• Increased risk of hyperkalemia in CKD or in those on K<sup>+</sup> supplements or K<sup>+</sup> sparing drugs</li> <li>• May cause acute renal failure in patients with severe bilateral renal artery stenosis</li> <li>• Do not use if history of angioedema with ARBs. Patients with a history of angioedema with an ACEI can receive an ARB beginning 6 weeks after ACEI discontinued</li> <li>• Avoid in pregnancy</li> </ul>
	Candesartan	8-32	1	
	Eprosartan	600-800	1 or 2	
	Irbesartan	150-300	1	
	Losartan	50-100	1 or 2	
	Olmesartan	20-40	1	
	Telmisartan	20-80	1	
	Valsartan	80-320	1	

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# Oral Antihypertensive Drugs

Class	Drug	Usual Dose Range (mg/d)	Daily Freq	Comments
<b>Primary agents</b>				
<b>CCB-dihydro-pyridines</b>	Amlodipine	2.5-10	1	<ul style="list-style-type: none"> <li>• Avoid use in patients with HFrEF; amlodipine or felodipine may be used if required</li> <li>• Associated with dose-related pedal edema, which is more common in women than men</li> </ul>
	Felodipine	5-10	1	
	Isradipine	5-10	2	
	Nicardipine	5-20	1	
	Nifedipine	60-120	1	
	Nisodipine	30-90	1	
<b>CCB-nondihydro-pyridines</b>	Diltiazem SR	180-360	2	<ul style="list-style-type: none"> <li>• Avoid routine use with beta blockers due to increased risk of bradycardia and heart block</li> <li>• Do not use in patients with HFrEF</li> <li>• Drug interactions with diltiazem and verapamil (CYP3A4 major substrate and moderate inhibitor)</li> </ul>
	Diltiazem ER	120-480	1	
	Verapamil IR	40-80	3	
	Verapamil SR	120-480	1 or 2	
	Verapamil-delayed onset ER (various forms)	100-480	1 pm	

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# Oral Antihypertensive Drugs

Class	Drug	Usual Dose Range (mg/d)	Daily Freq	Comments
<i>Secondary agents</i>				
<b>Diuretics – aldosterone antagonists</b>	Eplerenone	50-100	1-2	<ul style="list-style-type: none"> <li>• Preferred agents in primary aldosteronism and resistant hypertension</li> <li>• Spironolactone associated with greater risk of gynecomastia and impotence compared to eplerenone</li> <li>• Common add-on therapy in resistant hypertension</li> <li>• Avoid use with K<sup>+</sup> supplements, other K<sup>+</sup> sparing diuretics or significant renal dysfunction</li> <li>• Eplerenone often requires twice daily dosing for adequate BP lowering</li> </ul>
	Spironolactone	25-100	1	

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# Oral Antihypertensive Drugs

Class	Drug	Usual Dose Range (mg/d)	Daily Freq	Comments
<b>Secondary agents</b>				
<b>Beta Blockers- Cardio-selective</b>	Atenonlol	25-100	12	<ul style="list-style-type: none"> <li>• <b>Beta blockers are not recommended as first-line agents unless the patient has IHD or HF or aortic disease</b></li> <li>• <b>Preferred in patients with bronchospastic airway disease requiring a beta blocker</b></li> <li>• <b>Bisoprolol and metoprolol succinate preferred in patients with HFrEF</b></li> <li>• <b>Avoid abrupt cessation</b></li> </ul>
	Betaxolol	5-20	1	
	Bisoprolol	2.5-10	1	
	Metoprolol tartrate	100-400	2	
	Metoprolol succinate	50-200	1	
<b>Beta blockers</b>	Nebivolol	5-40	1	<ul style="list-style-type: none"> <li>• <b>Induces nitric oxide-induced vasodilation</b></li> <li>• <b>Avoid abrupt cessation</b></li> </ul>

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# Oral Antihypertensive Drugs

Class	Drug	Usual Dose Range (mg/d)	Daily Freq	Comments
<b>Secondary agents</b>				
<b>Beta blockers noncardio-selective</b>	Nadolol	40-120	1	<ul style="list-style-type: none"> <li>• Avoid in patients with reactive airways disease</li> <li>• Avoid abrupt cessation</li> </ul>
	Propranolol IR	160-480	2	
	Propranolol LA	80-320	1	
<b>Beta blockers intrinsic sympathomimetic activity</b>	Acebutolol	200-800	2	<ul style="list-style-type: none"> <li>• Generally avoid, especially in patients with IHD or HF</li> <li>• Avoid abrupt cessation</li> </ul>
	Carteolol	2.5-10	1	
	Penbutolol	10-40	1	
	Pindolol	10-60	2	

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# Oral Antihypertensive Drugs

Class	Drug	Usual Dose Range (mg/d)	Daily Freq	Comments
<b>Secondary agents</b>				
<b>Beta blockers combined alpha- and beta-receptor</b>	Carvedilol	12.5-50	2	<ul style="list-style-type: none"> <li>• Carvedilol preferred in patients with HFrEF</li> <li>• Avoid abrupt cessation</li> </ul>
	Carvedilol phosphate	20-80	1	
	Labetalol	200-800	2	
<b>Direct renin inhibitor</b>	Aliskiren	150-300	1	<ul style="list-style-type: none"> <li>• Do not use in combination with ACE inhibitors or ARBs</li> <li>• Aliskiren is very long acting</li> <li>• Increased risk of hyperkalemia in CKD or in those on K<sup>+</sup> sparing drugs</li> <li>• May cause acute renal failure in patients with severe bilateral renal artery stenosis</li> <li>• Avoid in pregnancy</li> </ul>

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# Oral Antihypertensive Drugs

Class	Drug	Usual Dose Range (mg/d)	Daily Freq	Comments
<b>Secondary agents</b>				
<b>Alpha-1 blockers</b>	Doxazosin	1-8	1	<ul style="list-style-type: none"> <li>• Associated with orthostatic hypotension, especially in older adults</li> <li>• May consider as second-line agent in patients with concomitant BPH</li> </ul>
	Prazosin	2-20	2 or 3	
	Terazosin	1-20	1 or 2	
<b>Central alpha<sub>1</sub>-agonist and other centrally acting drugs</b>	Clonidine oral	0.1-0.8	2	<ul style="list-style-type: none"> <li>• Generally reserved as last-line due to significant CNS adverse effects, especially in older adults</li> <li>• Avoid abrupt discontinuation of clonidine, which may induce hypertensive crisis; clonidine must be tapered to avoid rebound hypertension</li> </ul>
	Clonidine patch	0.1-0.3	1 weekly	
	Methyldopa	250-1000	2	
	Guanfacine	0.5-2	1	
<b>Direct vasodilators</b>	Hydralazine	200-250	2 or 3	<ul style="list-style-type: none"> <li>• Associated with sodium and water retention and reflex tachycardia; use with a diuretic and beta blocker</li> <li>• Hydralazine associated with drug-induced lupus-like syndrome at higher doses</li> <li>• Minoxidil associated with hirsutism and requires a loop diuretic. Can induce pericardial effusion</li> </ul>
	Minoxidil	5-100	1 or 3	

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# Nonpharmacological Interventions

<b>COR</b>	<b>LOE</b>	<b>Recommendations for Nonpharmacological Interventions</b>
<b>I</b>	<b>A</b>	Weight loss is recommended to reduce BP in adults with elevated BP or hypertension who are overweight or obese.
<b>I</b>	<b>A</b>	A heart-healthy diet, such as the DASH (Dietary Approaches to Stop Hypertension) diet, that facilitates achieving a desirable weight is recommended for adults with elevated BP or hypertension.
<b>I</b>	<b>A</b>	Sodium reduction is recommended for adults with elevated BP or hypertension.
<b>I</b>	<b>A</b>	Potassium supplementation, preferably in dietary modification, is recommended for adults with elevated BP or hypertension, unless contraindicated by the presence of CKD or use of drugs that reduce potassium excretion.

# Nonpharmacological Interventions

<b>COR</b>	<b>LOE</b>	<b>Recommendations for Nonpharmacological Interventions</b>
<b>I</b>	<b>A</b>	Increased physical activity with a structured exercise program is recommended for adults with elevated BP or hypertension.
<b>I</b>	<b>A</b>	Adult men and women with elevated BP or hypertension who currently consume alcohol should be advised to drink no more than 2 and 1 standard drinks* per day, respectively.

*\*In the United States, 1 “standard” drink contains roughly 14 g of pure alcohol, which is typically found in 12 oz of regular beer (usually about 5% alcohol), 5 oz of wine (usually about 12% alcohol), and 1.5 oz of distilled spirits (usually about 40% alcohol).*

# Best Proven Nonpharmacological Interventions for Prevention and Treatment of Hypertension\*

	Nonpharmacological Intervention	Dose	Approximate Impact on SBP	
			Hypertension	Normotension
Weight loss	Weight/body fat	Best goal is ideal body weight but aim for at least a 1-kg reduction in body weight for most adults who are overweight. Expect about 1 mm Hg for every 1-kg reduction in body weight.	-5 mm Hg	-2/3 mm Hg
Healthy diet	DASH dietary pattern	Consume a diet rich in fruits, vegetables, whole grains, and low-fat dairy products, with reduced content of saturated and total fat.	-11 mm Hg	-3 mm Hg
Reduced intake of dietary sodium	Dietary sodium	Optimal goal is <1500 mg/d, but aim for at least a 1000-mg/d reduction in most adults.	-5/6 mm Hg	-2/3 mm Hg
Enhanced intake of dietary potassium	Dietary potassium	Aim for 3500–5000 mg/d, preferably by consumption of a diet rich in potassium.	-4/5 mm Hg	-2 mm Hg

\*Type, dose, and expected impact on BP in adults with a normal BP and with hypertension.

DASH indicates Dietary Approaches to Stop Hypertension; and SBP, systolic blood pressure.

Resources: Your Guide to Lowering Your Blood Pressure With DASH—How Do I Make the DASH?

Available at: <https://www.nhlbi.nih.gov/health/resources/heart/hbp-dash-how-to>.

Top 10 Dash Diet Tips. Available at: [http://dashdiet.org/dash\\_diet\\_tips.asp](http://dashdiet.org/dash_diet_tips.asp)

# Best Proven Nonpharmacological Interventions for Prevention and Treatment of Hypertension\*

	Nonpharmacological Intervention	Dose	Approximate Impact on SBP	
			Hypertension	Normotension
Physical activity	Aerobic	<ul style="list-style-type: none"> <li>● 90–150 min/wk</li> <li>● 65%–75% heart rate reserve</li> </ul>	-5/8 mm Hg	-2/4 mm Hg
	Dynamic resistance	<ul style="list-style-type: none"> <li>● 90–150 min/wk</li> <li>● 50%–80% 1 rep maximum</li> <li>● 6 exercises, 3 sets/exercise, 10 repetitions/set</li> </ul>	-4 mm Hg	-2 mm Hg
	Isometric resistance	<ul style="list-style-type: none"> <li>● 4 × 2 min (hand grip), 1 min rest between exercises, 30%–40% maximum voluntary contraction, 3 sessions/wk</li> <li>● 8–10 wk</li> </ul>	-5 mm Hg	-4 mm Hg
Moderation in alcohol intake	Alcohol consumption	In individuals who drink alcohol, reduce alcohol <sup>†</sup> to: <ul style="list-style-type: none"> <li>● Men: ≤2 drinks daily</li> <li>● Women: ≤1 drink daily</li> </ul>	-4 mm Hg	-3 mm

\*Type, dose, and expected impact on BP in adults with a normal BP and with hypertension.

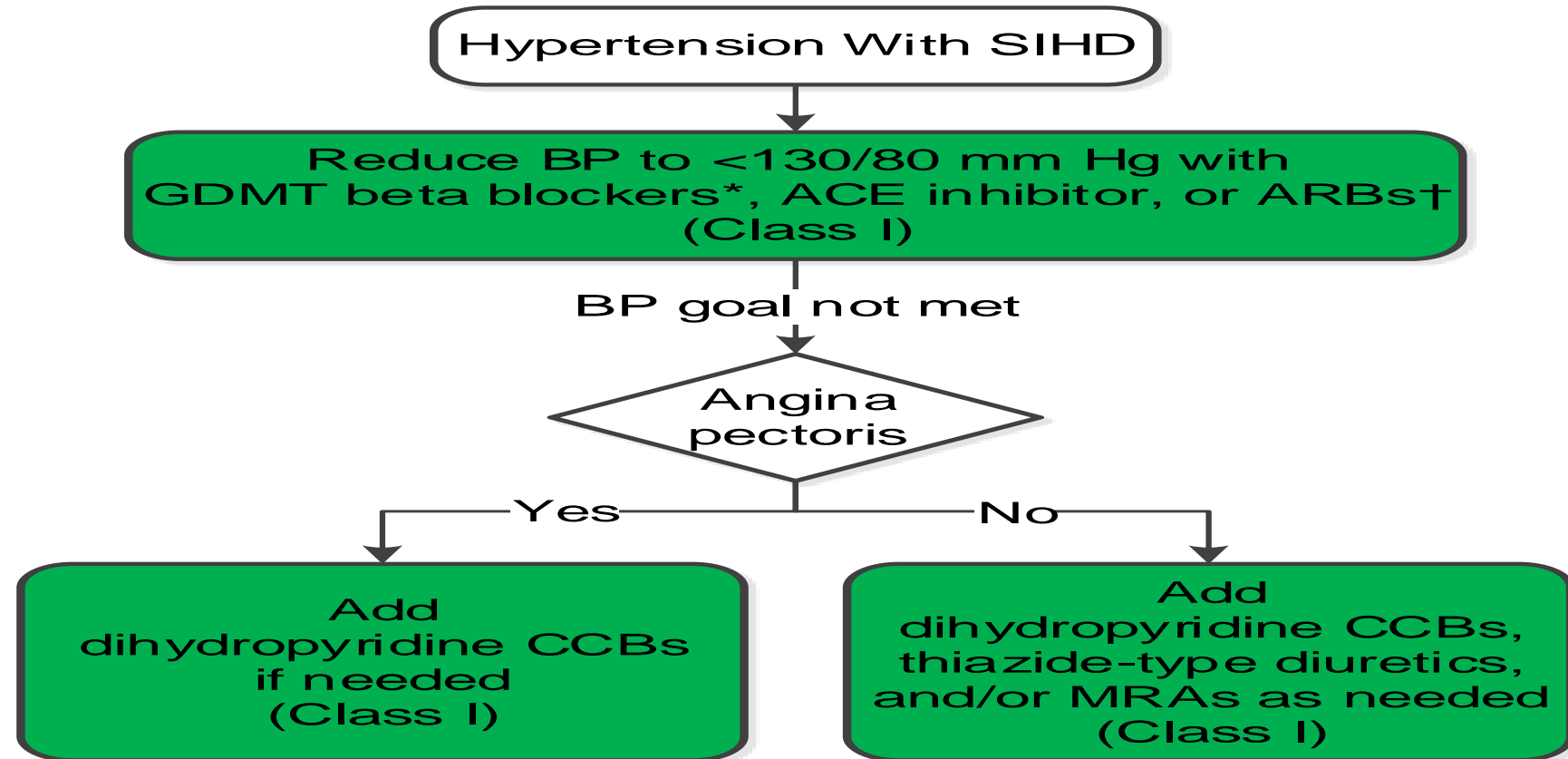
<sup>†</sup>In the United States, one “standard” drink contains roughly 14 g of pure alcohol, which is typically found in 12 oz of regular beer (usually about 5% alcohol), 5 oz of wine (usually about 12% alcohol), and 1.5 oz of distilled spirits (usually about 40% alcohol).

# 2017 Hypertension Guideline

## Special Considerations & Groups



# Management of Hypertension in Patients With SIHD



\*GDMT beta blockers for BP control or relief of angina include carvedilol, metoprolol tartrate, metoprolol succinate, nadolol, bisoprolol, propranolol, and timolol. Avoid beta blockers with intrinsic sympathomimetic activity. The beta blocker atenolol should not be used because it is less effective than placebo in reducing cardiovascular.



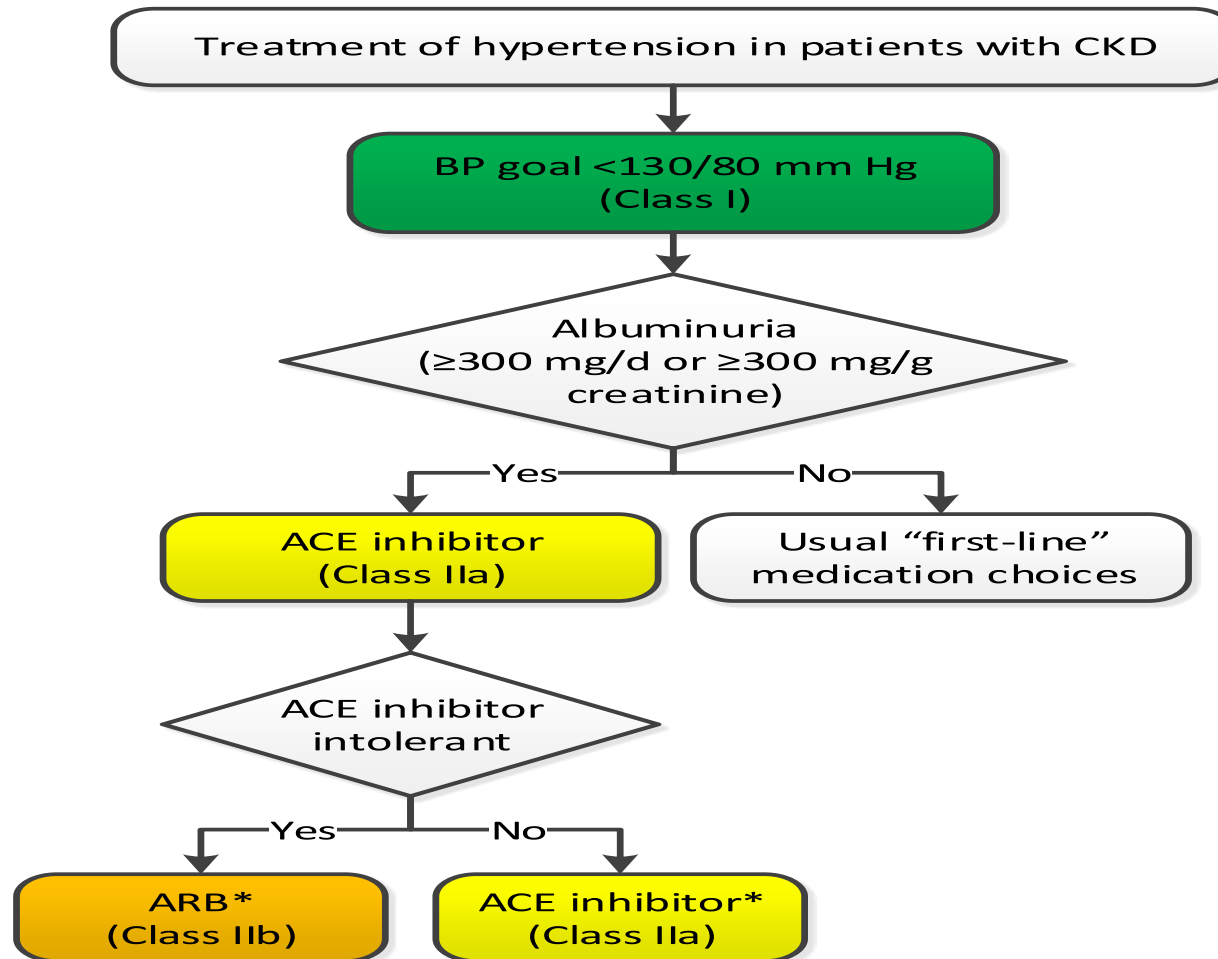
# Heart Failure With Reduced Ejection Fraction

<b>COR</b>	<b>LOE</b>	<b>Recommendations for Treatment of Hypertension in Patients With HFrEF</b>
<b>I</b>	<b>C-EO</b>	Adults with HFrEF and hypertension should be prescribed GDMT titrated to attain a BP of less than 130/80 mm Hg.
<b>III: No Benefit</b>	<b>B-R</b>	Nondihydropyridine CCBs are not recommended in the treatment of hypertension in adults with HFrEF.

# Heart Failure With Preserved Ejection Fraction

<b>COR</b>	<b>LOE</b>	<b>Recommendations for Treatment of Hypertension in Patients With HF<sub>p</sub>EF</b>
<b>I</b>	<b>C-EO</b>	In adults with HF <sub>p</sub> EF who present with symptoms of volume overload, diuretics should be prescribed to control hypertension.
<b>I</b>	<b>C-LD</b>	Adults with HF <sub>p</sub> EF and persistent hypertension after management of volume overload should be prescribed ACE inhibitors or ARBs and beta blockers titrated to attain SBP of less than 130 mm Hg.

# Management of Hypertension in Patients With CKD



# Diabetes Mellitus

COR	LOE	Recommendations for Treatment of Hypertension in Patients With DM
I	SBP: B-R <sup>SR</sup>	In adults with DM and hypertension, antihypertensive drug treatment should be initiated at a BP of 130/80 mm Hg or higher with a treatment goal of less than 130/80 mm Hg.
	DBP: C- EO	
I	A <sup>SR</sup>	In adults with DM and hypertension, all first-line classes of antihypertensive agents (i.e., diuretics, ACE inhibitors, ARBs, and CCBs) are useful and effective.
IIb	B-NR	In adults with DM and hypertension, ACE inhibitors or ARBs may be considered in the presence of albuminuria.

*SR indicates systematic review.*

# Valvular Heart Disease

COR	LOE	<b>Recommendations for Treatment of Hypertension in Patients With Valvular Heart Disease</b>
<b>I</b>	<b>B-NR</b>	In adults with asymptomatic aortic stenosis, hypertension should be treated with pharmacotherapy, starting at a low dose and gradually titrating upward as needed.
<b>IIa</b>	<b>C-LD</b>	In patients with chronic aortic insufficiency, treatment of systolic hypertension with agents that do not slow the heart rate (i.e., avoid beta blockers) is reasonable.

# Aortic Disease

COR	LOE	<b>Recommendation for Management of Hypertension in Patients With Aortic Disease</b>
I	C-EO	Beta blockers are recommended as the preferred antihypertensive agents in patients with hypertension and thoracic aortic disease.

# Racial and Ethnic Differences in Treatment

<b>COR</b>	<b>LOE</b>	<b>Recommendations for Race and Ethnicity</b>
<b>I</b>	<b>B-R</b>	In black adults with hypertension but without HF or CKD, including those with DM, initial antihypertensive treatment should include a thiazide-type diuretic or CCB.
<b>I</b>	<b>C-LD</b>	Two or more antihypertensive medications are recommended to achieve a BP target of less than 130/80 mm Hg in most adults with hypertension, especially in black adults with hypertension.

# Pregnancy

<b>COR</b>	<b>LOE</b>	<b>Recommendations for Treatment of Hypertension in Pregnancy</b>
<b>I</b>	<b>C-LD</b>	Women with hypertension who become pregnant, or are planning to become pregnant, should be transitioned to methyldopa, nifedipine, and/or labetalol during pregnancy.
<b>III: Harm</b>	<b>C-LD</b>	Women with hypertension who become pregnant should not be treated with ACE inhibitors, ARBs, or direct renin inhibitors.



# Age-Related Issues

COR	LOE	<b>Recommendations for Treatment of Hypertension in Older Persons</b>
<b>I</b>	<b>A</b>	Treatment of hypertension with a SBP treatment goal of less than 130 mm Hg is recommended for noninstitutionalized ambulatory community-dwelling adults ( $\geq 65$ years of age) with an average SBP of 130 mm Hg or higher.
<b>IIa</b>	<b>C-EO</b>	For older adults ( $\geq 65$ years of age) with hypertension and a high burden of comorbidity and limited life expectancy, clinical judgment, patient preference, and a team-based approach to assess risk/benefit is reasonable for decisions regarding intensity of BP lowering and choice of antihypertensive drugs.

# Clinician's Sequential Flow Chart for the Management of Hypertension

Clinician's Sequential Flow Chart for the Management of Hypertension
Measure office BP accurately
Detect white coat hypertension or masked hypertension by using ABPM and HBPM
Evaluate for secondary hypertension
Identify target organ damage
Introduce lifestyle interventions
Identify and discuss treatment goals
Use ASCVD risk estimation to guide BP threshold for drug therapy
Align treatment options with comorbidities
Account for age, race, ethnicity, sex, and special circumstances in antihypertensive treatment
Initiate antihypertensive pharmacological therapy
Insure appropriate follow-up
Use team-based care
Connect patient to clinician via telehealth
Detect and reverse nonadherence
Detect white coat effect or masked uncontrolled hypertension
Use health information technology for remote monitoring and self-monitoring of BP

*ASCVD indicates atherosclerotic cardiovascular disease; BP, blood pressure; CVD, cardiovascular disease; and SBP, systolic blood pressure.*

# Thank you

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On behalf of KHS, thank you for your continued partnership and service to our members.