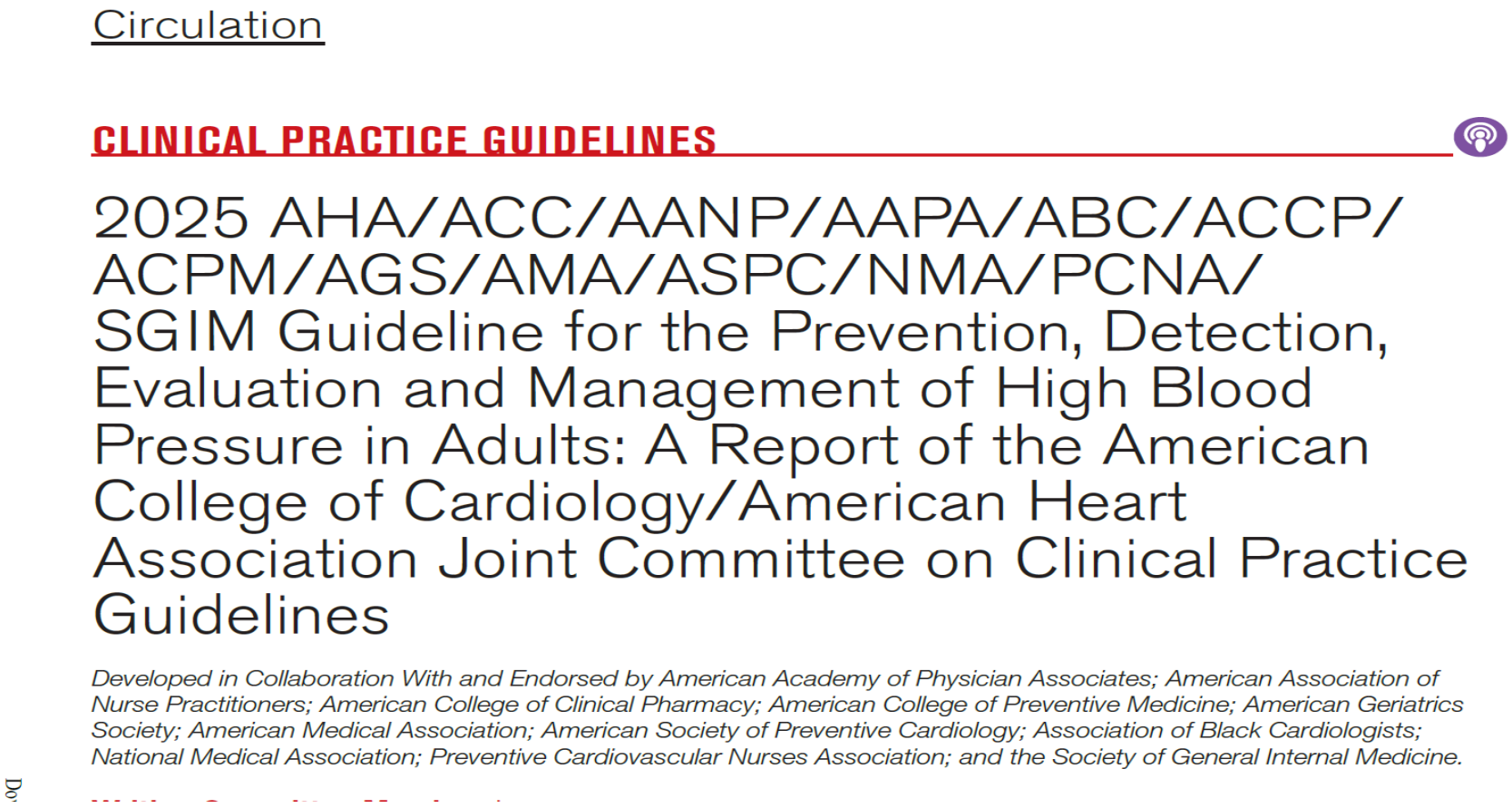
# 2025 ACC/AHA Hypertension Guideline Update

Farahnaz Dadras, MD

Iran University of Medical Sciences

# ACC/AHA Hypertension Guideline Update



Circulation

CLINICAL PRACTICE GUIDELINES

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

*Developed in Collaboration With and Endorsed by American Academy of Physician Associates; American Association of Nurse Practitioners; American College of Clinical Pharmacy; American College of Preventive Medicine; American Geriatrics Society; American Medical Association; American Society of Preventive Cardiology; Association of Black Cardiologists; National Medical Association; Preventive Cardiovascular Nurses Association; and the Society of General Internal Medicine.*

*Circulation*. 2025;152:e114–e218

- High blood pressure is the most prevalent and modifiable risk factor for the development of cardiovascular diseases, including
- **coronary artery disease,**
- **heart failure,**
- **atrial fibrillation,**
- **stroke,**
- **dementia,**
- **chronic kidney disease**,
- **all-cause mortality**.

- Clinicians should collaborate with community leaders, health systems, and practices to implement
- **screening of all adults** in their communities
- **implement guideline-based recommendations**
- regarding prevention and management of high blood pressure.

- **Multidisciplinary team-based care** is effective in **assessing** and addressing patient **access to medications** and other structural barriers to **support individual patient needs** and thereby reduce barriers to achieving hypertension control.

**Table 5. Prevalence of Hypertension* Among US Adults Aged 18 to 80 Years, 2017 to 2020**

| Demographic group | Prevalence | |
|---|---|---|
| | Men | Women |
| Overall | 49.5% (59.0 million) | 43.9% (56.3 million) |
| Age groups, y | | |
| 18-29 | 20.3% | 9.0% |
| 30-44 | 39.6% | 23.7% |
| 45-59 | 57.4% | 52.5% |
| 60-74 | 70.7% | 71.4% |
| 75-80 | 83.7% | 84.8% |
| Racial and ethnic groups (age-adjusted) | | |
| NH White | 47.0% | 39.0% |
| NH Black | 56.8% | 56.7% |
| NH Asian | 49.8% | 39.1% |
| Hispanic | 50.4% | 36.3% |
| Other | 50.7% | 47.9% |

*Hypertension defined as diagnosed hypertension, BP ≥130/80 mm Hg, or receiving antihypertensive therapy. Derived from NHANES.[9]

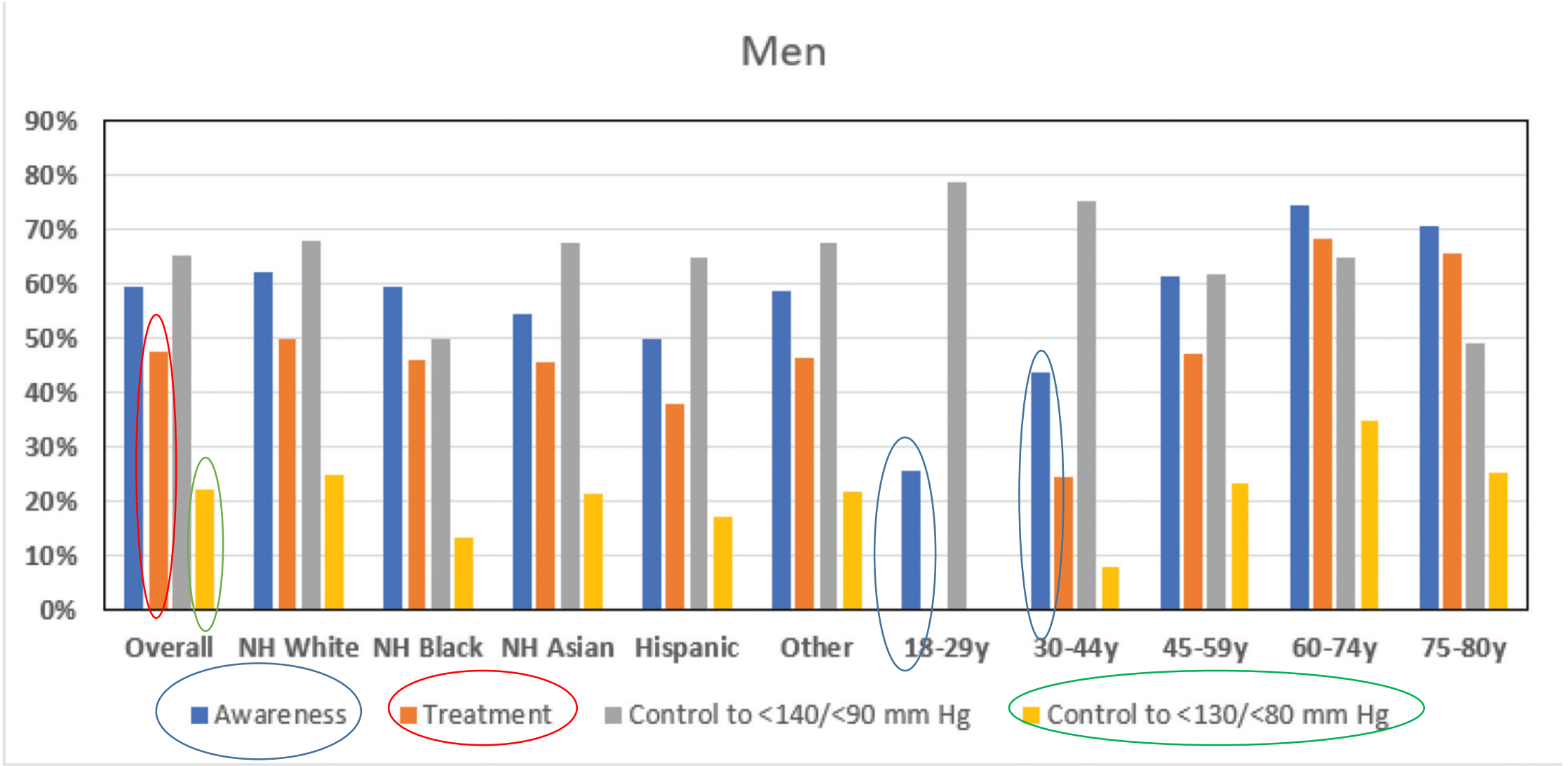
BP indicates blood pressure; and NH, non-Hispanic.

## Table 4. Categories of Blood Pressure in Adults*

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

BP indicates blood pressure (based on an average of ≥2 careful readings obtained on ≥2 occasions, as detailed in Section 3 (“Evaluation and Diagnosis”); DBP, diastolic blood pressure; and SBP, systolic blood pressure.

*Adults with SBP and DBP in 2 categories should be designated to the higher BP category. This table excludes individuals who are pregnant (see Section 11.5, “Hypertension and Pregnancy”). Adapted with permission from Whelton et al.[5] Copyright 2018 American College of Cardiology Foundation and American Heart Association, Inc.


Men
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Overall
NH White
NH Black
NH Asian
Hispanic
Other
18-29y
30-44y
45-59y
60-74y
75-80y
Awareness
Treatment
Control to <140/<90 mm Hg
Control to <130/<80 mm Hg

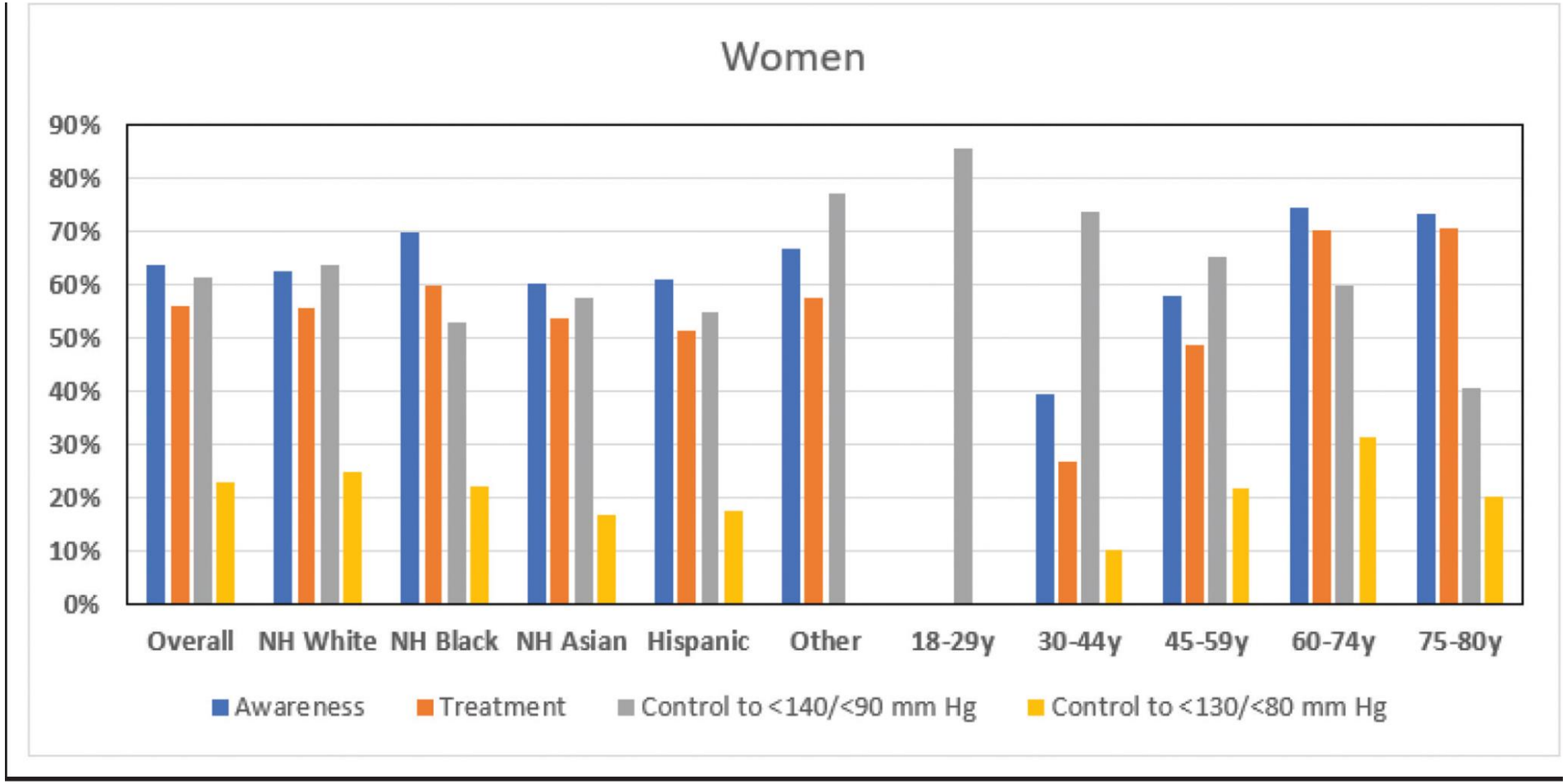



**Figure 1. Rates of Awareness, Treatment, and Control of Hypertension Among US Adults Aged 18 to 80 Years, 2017 to 2020***.
*Missing data points indicate uncertain estimates due to small sample sizes for that subgroup. NH indicates non-Hispanic. Derived from NHANES.[9]

- Hypertension frequently co-occurs with other CVD risk factors. From 2017 to 2020, of adults with hypertension in the United States

- **16.6%**were **current smokers**,
- **72.6%** were **overweight or obese**,
- **12.3%** had **diabetes,**
- **13.4%** had diagnosed **CKD**,

- leading to additive and **synergistic risks for CVD** is associated with fatal and nonfatal cardiovascular events in a **graded**, **log-linear fashion**, with an approximate **doubling of risk** for each **20-mm Hg higher SBP** and **10-mm Hg higher DBP** level Hypertension frequently co-occurs with other CVD risk factors.

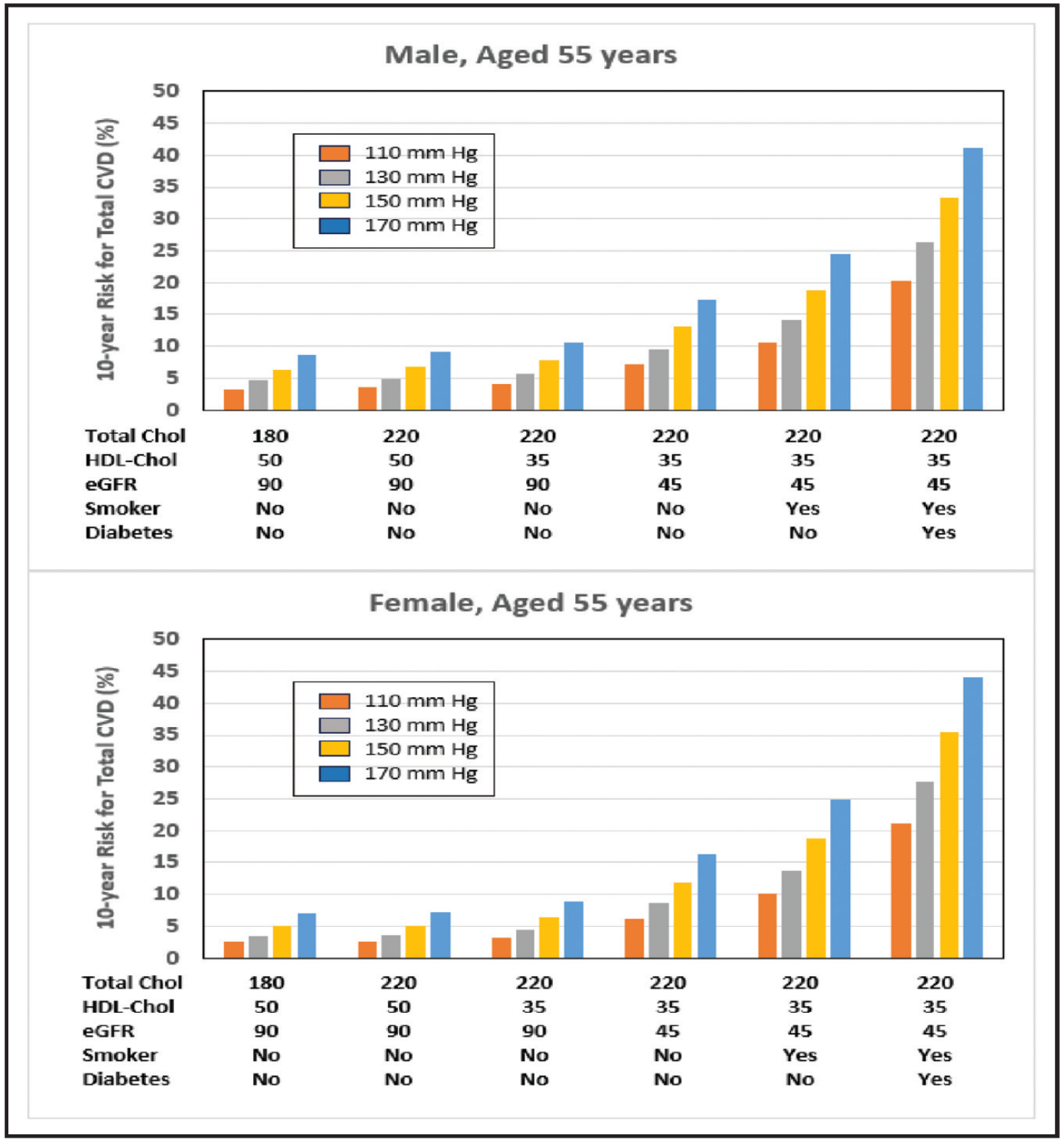



**Figure 2. Estimated 10-Year Risks for Total Cardiovascular Disease Using the PREVENT™ CVD Risk Equations, Stratified by Blood Pressure Levels With Selected Combinations of Risk Factors.**

CVD indicates cardiovascular disease; eGFR, estimated glomerular filtration rate; and HDL, high-density lipoprotein. Derived from Khan et al[19,20] via PREVENT.

# 3.1. Patient Evaluation

## *3.1.1. Accurate Measurement of In-Office BP*

| Recommendations for Accurate Measurement of In-Office BP | | |
|---|---|---|
| **COR** | **LOE** | **Recommendations** |
| **1** | **C-LD** | 1. When diagnosing and managing high BP in adults, standardized methods are recommended for the accurate measurement and documentation of in-office BP (Figure 3).[1–3] |
| **2a** | **C-EO** | to use the oscillometric method with an automated device over the auscultatory method |

- Oscillometric devices estimate BP by measuring oscillations during cuff inflation or deflation.

- At the point of **maximum cuff oscillations**, the BP in the cuff is equivalent to the **mean BP in the artery**, and **SBP and DBP** are estimated using proprietary **manufacturer algorithms**.

- For this reason, only oscillometric devices that were validated with a rigorous standardized protocol with BP measurement using a reference standard are recommended for use (termed validated devices.
- See **https://www.validatebp.org**

# Accurate Office Blood Pressure Measurement

- Office BP should be based on the average of available readings, and an **average of 2 BP measurements** obtained on **≥2 separate occasions** may minimize error.
- Regardless of the office BP measurement approach, clinicians and **staffs** should have initial and ongoing training, including **competency** checks ideally **every 6 to 12 months**, to maintain best practices for measuring BP.

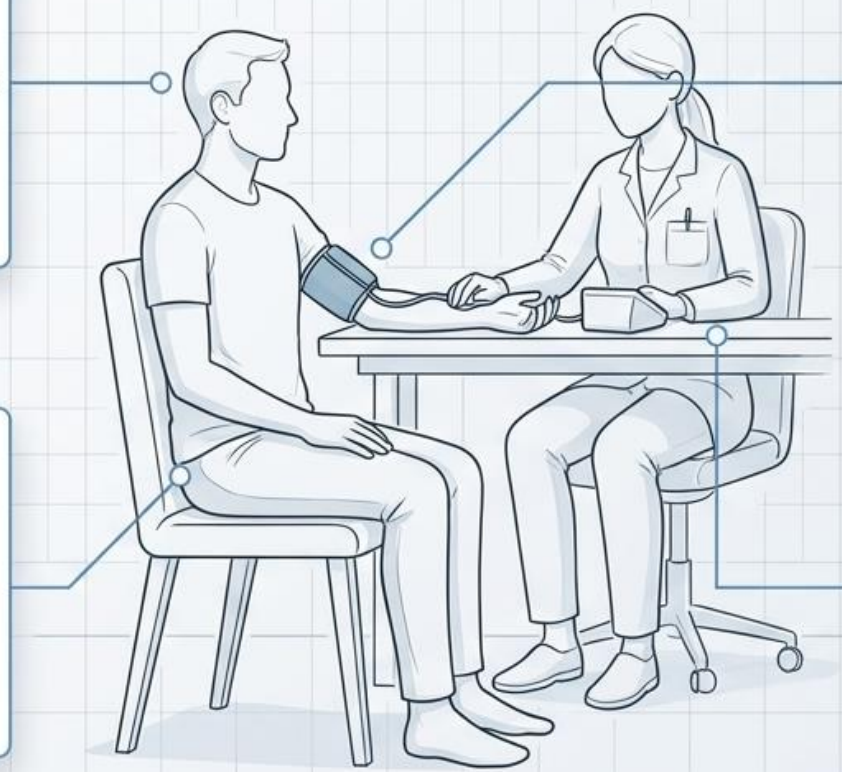
# Precision Measurement: The In-Office Blueprint

## 1 Environment & Prep

- Avoid caffeine, exercise, and smoking 30 mins prior.
- Empty bladder.
- Temperature-controlled room.

## 2 Posture

- Back supported.
- Feet flat on floor, legs uncrossed.
- Sit relaxed for >5 minutes.



## 3 Arm & Device

- Bare arm supported at heart level.
- Use the correct cuff size.
- Use a validated oscillometric device.

## 4 Execution

- No talking (patient or clinician).
- Take ≥2 readings at least 1 minute apart.
- Average the readings.

NotebookLM

## Table 6. Routine Laboratory Testing for New Diagnosis of Hypertension

| Diagnostic Tests |
|---|
| Complete blood count |
| Serum sodium, potassium, calcium |
| Serum creatinine with estimation of glomerular filtration rate (based on the 2021 CKD-EPI Creatinine Equation) |
| Lipid profile |
| Fasting blood glucose or Hemoglobin A1c |
| Thyroid-stimulating hormone |
| Urinalysis |
| Urine albumin-to-creatinine ratio; urine protein-to-creatinine ratio |
| ECG |

Modified with permission from Whelton et al.[4] Copyright 2018 American College of Cardiology Foundation and American Heart Association, Inc.

ECG indicates electrocardiogram.

- **Electrocardiography** can provide important information on **subclinical CVD** (eg, left ventricular hypertrophy), and **cardiac biomarkers**, **echocardiography**, and **coronary artery calcium scoring** allow more refined risk estimation for CVD and assessment of the prevalence and extent of subclinical CVD.

- **AOBP** is typically measured without a clinician present (ie, unattended AOBP).
- Regardless of the measurement approach, **errors in measurement** technique **are common** if the measurements are taken incorrectly in terms of patient preparation and positioning, environment, and equipment and can result in a misleading estimation of an individual's true in-office BP level.

# Out-of-office BP measurement( ABPM or HBPM)

- **Confirmation** and **management** of hypertension
- **Greater number of BP measurements**

- ABPM can:
- 1) provide estimates of **mean BP** over the entire monitoring period

, and separately during **daytime** and **night-time**

- 2) determine the **daytime-to-night-time BP** ratio to identify the extent of nocturnal “**dipping**”
- 3) identify the **early-morning BP surge pattern**;
- 4) estimate **BP variability**;
- 5) allow for **recognition of hypotension**

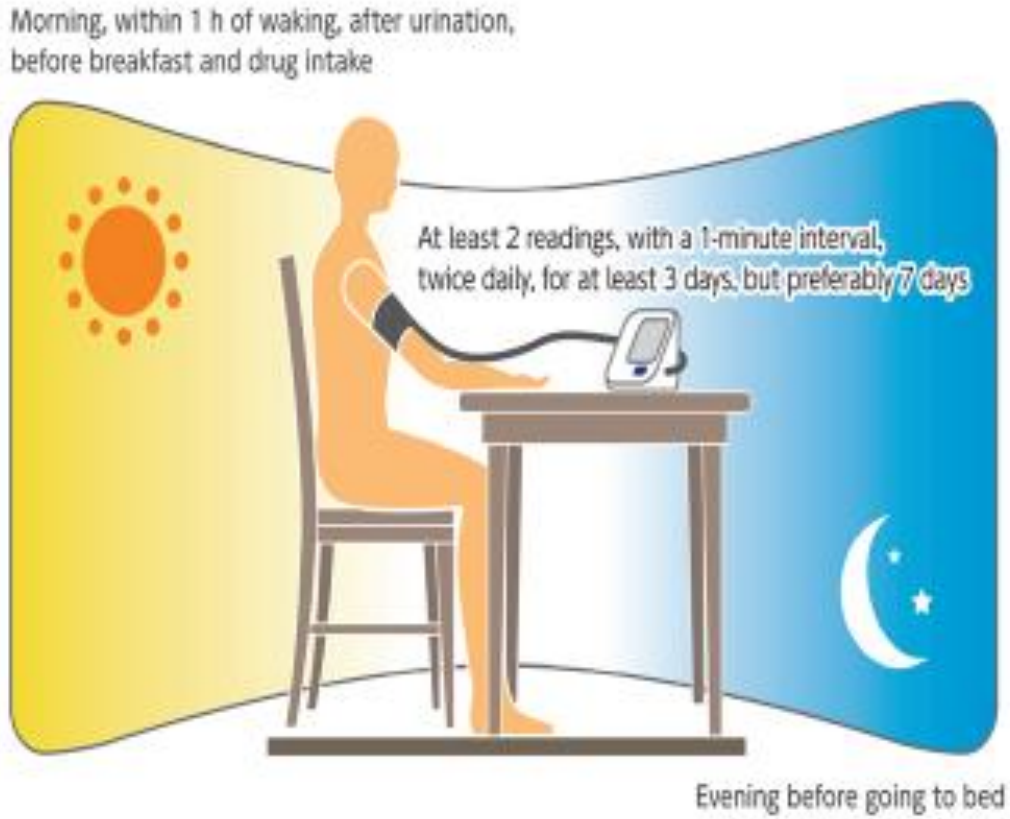
- ABPM or HBPM are recommended to **confirm the diagnosis** of hypertension

- 2. In adults who are taking antihypertensive medication, **HBPM** is recommended for monitoring the titration of BP-lowering medication, along with co-interventions such as **patient telehealth counseling**, and **clinical interventions**, **education**.

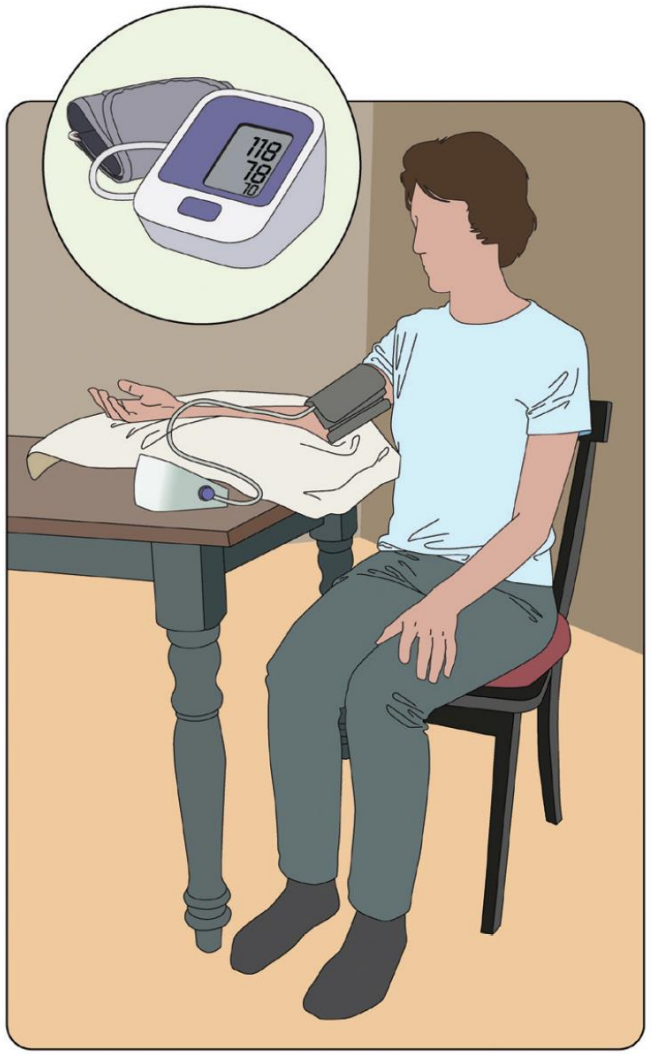
- Evidence suggests that **HBPM more strongly predicts CVD outcomes** than office BP and may be more reproducible than ABPM.

High-quality evidence supports the **use of HBPM** in combination with **cointerventions**, such as **patient education**, **telehealth** , and **medication titration** using prespecified algorithms, for the longitudinal management of BP.

- Meta-analyses of RCTs have identified **modest reductions in office SBP** and **DBP** at **6 months and 1year** with the **use of HBPM** on its own without cointerventions, as compared with usual care.




American Journal of Hypertension 34(8) August 2021




## Home Blood Pressure Monitoring

**Device and blood pressure cuff**

Use a blood pressure device that has been validated for accuracy. Check with your clinician or other members of your care team, and the following website for devices: www.validatebp.org.

Use the correct cuff size matched to the size of your arm.

**Patient preparation**

Avoid smoking, caffeinated beverages, or exercise within 30 minutes before blood pressure measurements.

**Positioning of patient and cuff**

Place the cuff on a bare arm, and your arm should be supported at heart level.

The bottom of the cuff should be placed directly above the bend of the elbow.

You should relax, and sit in a chair (feet on floor, legs uncrossed, and back supported) for at least 5 minutes.

**Blood pressure measurement**

While relaxing and measuring your blood pressure, please do not talk, use your phone, or watch TV.

You should take 2 readings 1 min apart twice a day (for a total of 4 readings): 2 readings in the morning after emptying your bladder (urinating) and before taking your medication and eating; and 2 readings at bedtime before sleep.

Check blood pressure for 3 days (minimum) to 7 days (preferred) before your appointment or interaction with your clinician.

Document your daily blood pressure measurements in writing or electronically.

Share your readings with the clinician taking care of you.

**Figure 4. Home Blood Pressure Monitoring.**[18]

See Table 7 for HBPM targets. BP indicates blood pressure; and HBPM, home blood pressure monitoring. Adapted with permission from Wheltor et al.[19] Copyright 2019 American College of Cardiology Foundation and American Heart Association, Inc. Created by Sceyence Studios.

**Table 7. Values of Systolic/Diastolic Blood Pressure for Ambulatory and Home Blood Pressure Monitoring Corresponding to Office Systolic/Diastolic Blood Pressure Levels**

| 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 |

Modified with permission from Whelton et al.[19] Copyright 2018 American College of Cardiology Foundation and American Heart Association, Inc.

ABPM indicates ambulatory blood pressure monitoring; BP, blood pressure; DBP, diastolic blood pressure; HBPM, home blood pressure monitoring; and SBP, systolic blood pressure.

## Table 8. Environmental, Behavioral, and Genetic Causes of Hypertension

| Dietary Intake Factors | Nondietary Factors |
|---|---|
| Higher sodium intake | Genetic variants |
| Lower potassium intake | Overweight/obesity |
| Lower calcium/magnesium intake | Lower physical activity/fitness |
| Lower diet quality (lower intake of fruits/vegetables, plant proteins, fiber) | Sleep disturbances (related to duration, quality, regularity, and/or disordered breathing) |
| Alcohol intake | Psychosocial stressors |
| | Air pollution |

# The 2025 Paradigm Shift: Key Guideline Updates

## Risk Assessment

The shift to the **PREVENT™ calculator ( ≥7.5% 10-year risk threshold)** for initiating pharmacotherapy in **Stage 1 HTN**, replacing the older **Pooled Cohort Equations** (PCE).

## Pharmacology

For **Stage 2 Hypertension** (≥140/90), the preferred initiation is **two first-line agents** in a **Single-Pill Combination (SPC)** to drive adherence.

## Secondary Screening

**Universal screening** for **Primary Aldosteronism** is now recommended for **ALL adults** with **resistant hypertension**, regardless of whether hypokalemia is present.

## Cognitive Preservation

A strict goal of **SBP <130 mm Hg** is now a **Class 1 recommendation** specifically to prevent **mild cognitive impairment** and **dementia**.

NotebookLM

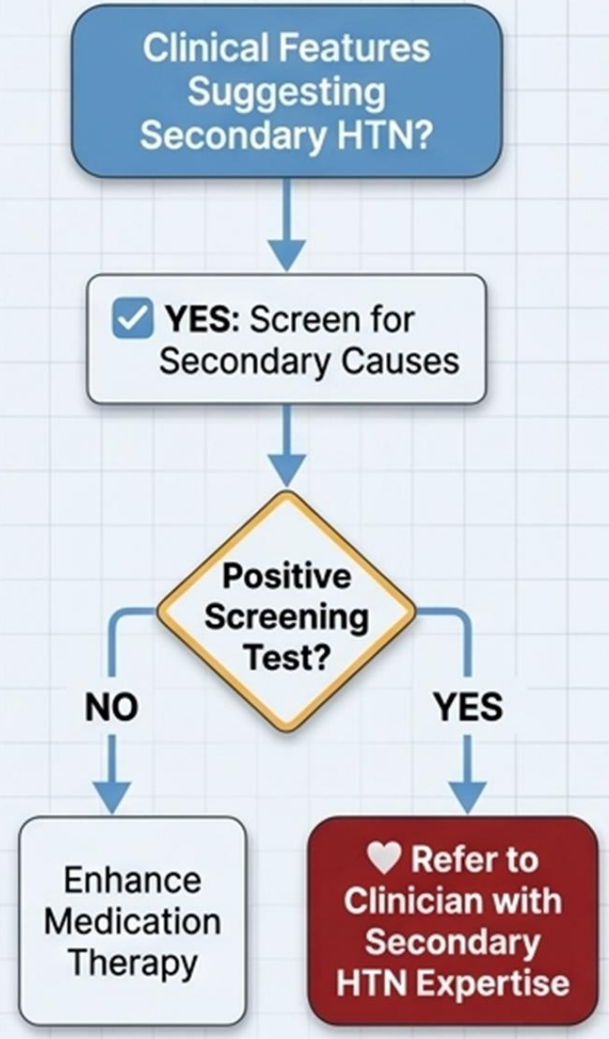
# Recommendations for Secondary Forms of Hypertension

- Screening for specific forms of secondary hypertension is recommended when **clinical suspicion** is present.

- In adults with **resistant hypertension**, **screening for primary aldosteronism** is recommended regardless of whether hypokalemia is present.

# Hunting for Zebras: Secondary Causes of Hypertension

| Cause & Prevalence | Clinical Red Flags | Diagnostic Workup |
| --- | --- | --- |
| **Primary Aldosteronism** (5-25% prevalence) | **Resistant HTN, hypokalemia** (though absent in most cases), **OSA**, incidental adrenal mass. | **Plasma aldosterone-to-renin ratio.** **2025 Update:** Do NOT stop most antihypertensives (except MRAs) prior to initial screening to avoid delays. |
| **Obstructive Sleep Apnea** (25-50% prevalence) | **Snoring**, daytime **sleepiness**, resistant/nocturnal HTN, large neck circumference. | **STOP-Bang** Questionnaire, sleep study. |
| **Renovascular Hypertension** (0.1-5% prevalence) | **Flash pulmonary edema, abdominal bruit**, abrupt worsening of BP. | Renal duplex Doppler ultrasound or CT angiogram. |




NotebookLM

**Table 10. Causes of Secondary Hypertension With Indications for Additional Testing and Diagnostic Screening Tests**

| | Prevalence | Indications for Additional Testing | Physical Examination Findings | Screening Tests | Confirmatory Tests |
|---|---|---|---|---|---|
| **Common causes** | | | | | |
| OSA[5–7] | 25%-50% | Snoring, choking, gasping during sleep; daytime sleepiness; resistant hypertension | Obesity, large neck size (eg, >17 inches [men]; >16 inches [women], Mallampati class 3-4; loss of normal nocturnal BP fall | STOP-Bang Questionnaire[15]; Berlin Questionnaire[16]; overnight oximetry | Referral for polysomnography or home sleep apnea testing if no suspicion of nonrespiratory sleep disorders (eg, narcolepsy) |
| CKD[17,18] | 14% | Diabetes, obstruction, hematuria; urinary frequency and nocturia; urinary incontinence, analgesic abuse; family history of polycystic kidney disease; elevated serum creatinine; abnormal urinalysis | Abdominal mass or large palpable kidneys (polycystic kidney disease); skin pallor | Electrolytes, including sodium, potassium, chloride, and bicarbonate, serum creatinine, urinalysis, urine microalbumin, serum cystatin C, renal ultrasound | Tests to evaluate cause of CKD |
| Primary aldosteronism[1–3,9,19] | 5%-25% | Resistant hypertension; hypertension with hypokalemia (spontaneous or diuretic induced); hypertension and muscle cramps or weakness; hypertension and incidentally discovered adrenal mass; hypertension and obstructive sleep apnea; hypertension and family history of early-onset hypertension or stroke | Arrhythmias (with hypokalemia); especially AF | Electrolytes, including sodium and potassium, plasma aldosterone/renin activity ratio (correction of hypokalemia and withdrawal of MRA for 4-6 wks) | Oral sodium loading test (with 24-h urine aldosterone) or IV saline infusion test with plasma aldosterone at 4 h of infusion or captopril suppression test (in patients not on ACEi or ARB treatment), adrenal CT scan, adrenal vein sampling |

| | | | | | |
|---|---|---|---|---|---|
| Drug or alcohol induced[11] | 2%-20% | Sodium-containing antacids; antidepressants; nicotine (smoking); alcohol; NSAIDs; oral contraceptives; cyclosporine or tacrolimus; sympathomimetics (decongestants, anorectics); cocaine, amphetamines and other illicit drugs; neuropsychiatric agents; erythropoiesis-stimulating agents; cancer treatment (VEGF inhibitors, Bruton tyrosine kinase inhibitors and others), clonidine withdrawal; herbal agents (Ma Huang, ephedra) | Fine tremor, tachycardia, sweating (cocaine, ephedrine, MAO inhibitors); acute abdominal pain (cocaine) | Urinary drug screen (illicit drugs) | Response to withdrawal of suspected agent |
| Renovascular hypertension[10] | 0.1%-5% | Resistant hypertension; hypertension of abrupt onset or worsening or increasingly difficult to control; flash pulmonary edema (atherosclerotic); early-onset hypertension, especially in women (fibromuscular hyperplasia) | Abdominal systolic-diastolic bruit; bruits over other arteries (carotid, femoral) | Electrolytes, including sodium, potassium, chloride, and bicarbonate, renal duplex Doppler ultrasound; magnetic resonance arteriography; abdominal CT arteriography | Bilateral selective renal intra-arterial angiography |

| **Uncommon causes** | | | | | |
|---|---|---|---|---|---|
| Hypothyroidism[20] | <1% | Dry skin; cold intolerance; constipation; hoarseness; weight gain | Delayed ankle reflex; periorbital edema; coarse skin; cold skin; slow movement; goiter | Thyroid-stimulating hormone; free thyroxine | None |
| Hyperthyroidism[20] | <1% | Warm, moist skin; heat intolerance; nervousness; tremulousness; palpitations, insomnia; weight loss; diarrhea; proximal muscle weakness | Lid lag; fine tremor of the outstretched hands; warm, moist skin, goiter, thyroid nodule | Thyroid-stimulating hormone; free thyroxine | Radioactive iodine uptake and scan |
| Pheochromocytoma/paraganglioma[21,22] | <0.6% | Resistant hypertension; paroxysmal hypertension or crisis superimposed on sustained hypertension; "spells," BP lability, headache, sweating, palpitations, piloerection; positive family history of pheochromocytoma/paraganglioma; adrenal incidentaloma | Skin stigmata of neurofibromatosis (café-au-lait spots; neurofibromas); orthostatic hypotension | 24-h urinary fractionated metanephrines or plasma metanephrines under standard conditions (supine position with indwelling IV cannula) | CT or MRI scan of abdomen/pelvis, Ga-DOTATATE PET/CT scan |

| | Prevalence | Indications for Additional Testing | Physical Examination Findings | Screening Tests | Confirmatory Tests |
|---|---|---|---|---|---|
| Aortic coarctation (undiagnosed or repaired)[23] | 0.1% | Young adult with hypertension (age <30 y) | BP higher in upper extremities than in lower extremities; absent femoral pulses; continuous murmur over patient's back, chest, or abdominal bruit; left thoracotomy scar (postoperative) | Echocardiogram | Thoracic and abdominal CT angiogram or magnetic resonance arteriography |
| Cushing syndrome[24] | <0.1% | Rapid weight gain, especially with central distribution; proximal muscle weakness; depression; hyperglycemia | Central obesity, "moon" face, dorsal and supraclavicular fat pads, wide (1 cm) violaceous striae, hirsutism | Overnight 1-mg dexamethasone suppression test | 24-h urinary free cortisol excretion (preferably multiple); midnight salivary cortisol |
| Primary hyperparathyroidism[20] | Rare | Hypercalcemia | Usually none | Serum calcium | Serum parathyroid hormone |
| Congenital adrenal hyperplasia[20] | Rare | Hypertension and hypokalemia; virilization (11-beta-hydroxylase deficiency [11-beta-OH]); incomplete masculinization in men and primary amenorrhea in women (17-alpha-hydroxylase deficiency [17-alpha-OH]) | Signs of virilization (11-beta-OH) or incomplete masculinization (17-alpha-OH) | Hypertension and hypokalemia with low or normal aldosterone and renin | 11-beta-OH: elevated DOC, 11-deoxycortisol, and androgens; 17-alpha-OH; decreased androgens and estrogen but elevated DOC and corticosterone |
| Mineralocorticoid excess syndromes other than primary aldosteronism[20] | Rare | Early-onset hypertension; resistant hypertension; hypokalemia or hyperkalemia | Arrhythmias (with hypokalemia) | Low aldosterone and renin | Urinary cortisol metabolites; genetic testing |
| Acromegaly[25] | Rare | Acral features, enlarging shoe, glove, or hat size; headache, visual disturbances; diabetes | Acral features; large hands and feet; frontal bossing | Serum growth hormone ≥1 ng/mL during oral glucose load | Elevated age- and sex-matched IGF-1 level; MRI scan of the pituitary |

# Recommendations for Primary Aldosteronism

- In adults with hypertension, screening for primary aldosteronism is recommended in the presence of any of the following conditions to increase rates of detection, diagnosis, and specific targeted therapy:

- Resistant hypertension (regardless of whether hypokalemiais present),
- Hypokalemia (spontaneous or diuretic induced),
- OSA
- Incidentally discovered adrenal mass,
- Family history of early-onset hypertension,
- Stroke at a young age (<40 years)

# Recommendations for Primary Aldosteronism

- In adults with **stage 2 hypertension**, screening for primary aldosteronism may be considered to increase rates of detection, diagnosis, and specific targeted therapy.

- In adults with an indication for screening for primary aldosteronism, use of plasma aldosterone, renin activity, and the **plasma aldosterone** to **renin activity ratio** is recommended for initial screening to assess if thereis biochemical evidence of primary aldosteronism.

- In adults with an indication for screening for primary aldosteronism, it is recommended **to continue most antihypertensive medications** (**other than** mineralocorticoid receptor antagonists [**MRAs**]) prior toinitial screening to minimize barriers to or delays inscreening.

- **Primary aldosteronism** is a common cause of secondary hypertension (occurring in **5% to 10%** of patients with hypertension and **20% of** patients with **resistant hypertension.**

- Targeted treatment is associated with improved kidney and cardiovascular outcomes.

- Nonetheless, **rates of screening** for primary aldosteronism in appropriate patients are exceptionally **low (1% to 2%)**.

# Organ damage risk and primary hyperaldosteronism

- Patients with **primary aldosteronism** are at **greater risk for target organ damage** than those with **primary** hypertension.

- Meta-analyses of studies that matchedpatients with primary aldosteronism to those with primary hypertension showed that primary aldosteronism carries a
- **2.0-fold increased risk of HF**,
- **2.8-fold** increased risk of **stroke**,
- **1.7-fold** increased risk of **coronary artery disease**
- **, 4.0-fold** increased risk of **AF,**
- **increased kidney damage**
- compared with primary hypertension.

- Patients with hypertension and adrenal “**incidentaloma**,” an incidentally discovered adrenal lesion on computed tomography or magnetic resonance imaging performed for other purposes.

- Additionally, patients with **resistant hypertension** (regardless of whether hypokalemia is present), hypertension with **hypokalemia** (either spontaneous or diuretic-induced), and hypertension with **OSA** have a relatively high prevalence of **primary aldosteronism(~20%-35%)**.

- Patients with hypertension and a history of **early-onset hypertension** and/or **cerebrovascular accident at a young age** may have **primary** aldosteronism due to **glucocorticoid-remediable aldosteronism** (familial hyperaldosteronism **type-1**) and therefore also warrant screening.

- Patients with primary aldosteronism typically have **suppressed renin activity (<1 ng/mL/h)**.

- Most data support that the **plasma aldosterone** concentration should be at least 10 ng/dL to interpret the test as positive.
- The **most commonly used cutoff** value for the aldosterone to renin activity ratio is **30.**

- Patients should have **unrestricted salt intake**, **serum potassium in the normal range** (to avoid false-negative testing), and ideally, **MRA** (eg, spironolactone or eplerenone) **withdrawn for at least 4 weeks** before testing.

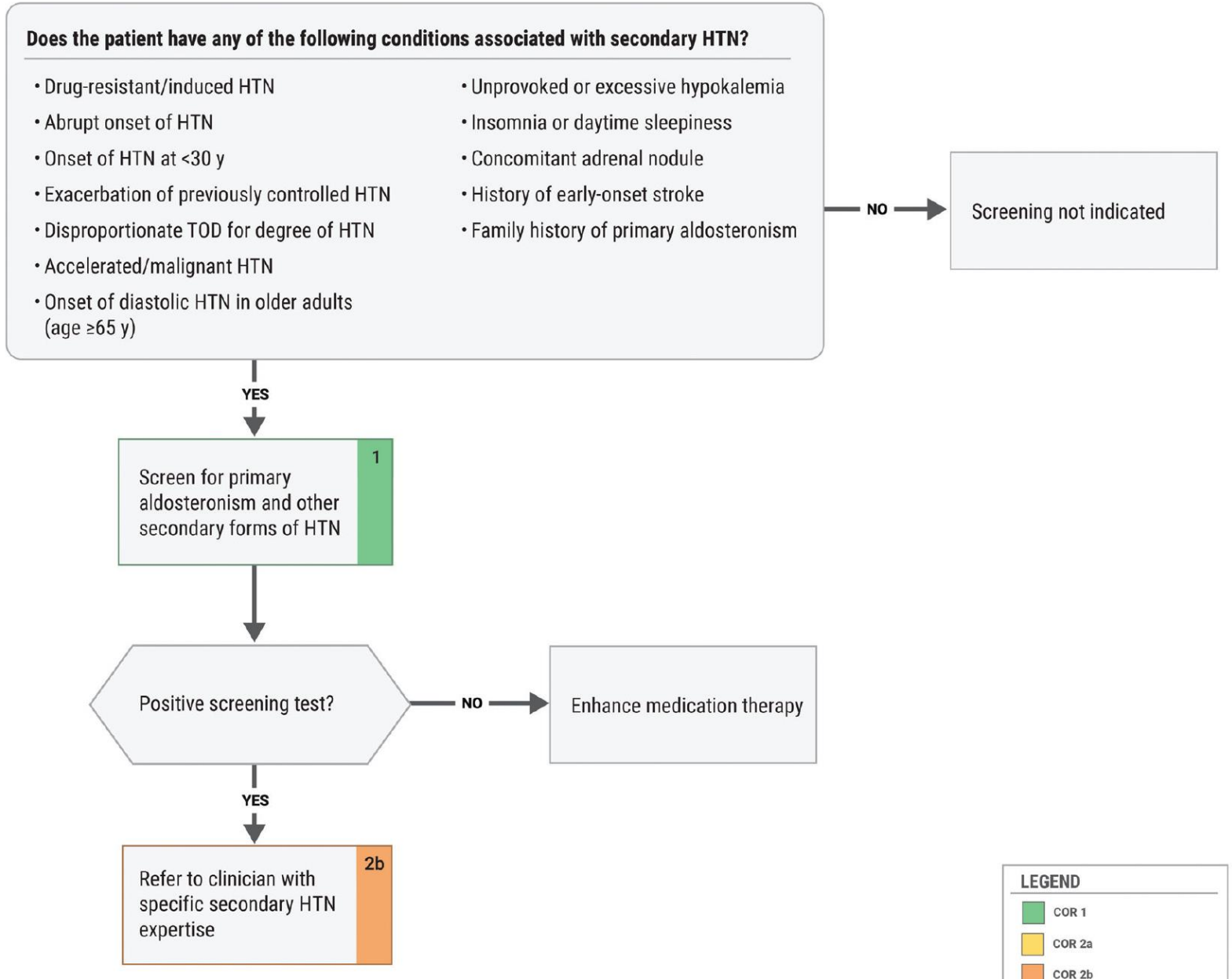
- **Beta blockers (BBs) and central-alpha agonists** can **suppress both renin** and **aldosterone.**
- **ACEis** and angiotensin receptor blockers (**ARBs**) may **stimulate renin** and **suppress aldosterone**
- **Thiazide, loop diuretics, MRA, and potassium-sparing diuretics** can **stimulate both renin and aldosterone**

- **Noninterfering medications** type, (ie, **non-dihydropyridine calcium channel** blockers[CCBs**], vasodilators**, **peripheral alpha-blockers,** and potentially **dihydropyridine for at least2 to 4 weeks prior to repeat testing**.

- The diagnosis of primary aldosteronism may require an aldosterone **suppression test** such as an intravenous
- (IV) saline suppression test or oral salt-loading test.

- If the diagnosis of primary aldosteronism is confirmed and the patient agrees that surgery would be desirable, the patient is referred for an **adrenal venous sampling** procedure to determine whether theincreased aldosterone production is **unilateral or bilateral** in origin.

# Screening for Features Suggesting Secondary Hypertension



# Screening for Features Suggesting Secondary Hypertension

**Does the patient have any of the following conditions associated with secondary HTN?**

- Drug-resistant/induced HTN
- Abrupt onset of HTN
- Onset of HTN at <30 y
- Exacerbation of previously controlled HTN
- Disproportionate TOD for degree of HTN
- Accelerated/malignant HTN
- Onset of diastolic HTN in older adults (age ≥65 y)
- Unprovoked or excessive hypokalemia
- Insomnia or daytime sleepiness
- Concomitant adrenal nodule
- History of early-onset stroke
- Family history of primary aldosteronism

NO → Screening not indicated

**Table 11. Selected List of Frequently Used Medications and Other Substances That May Cause Elevated Blood Pressure With Recommendations for Management***

| Agent | Possible Management Strategy |
|---|---|
| **Nonprescription drugs/substance** | |
| Alcohol | Options include abstinence or limit alcohol to ≤1 drink daily for women and ≤2 drinks daily for men[26,27] |
| Caffeine[28] | Limit caffeine intake to <300 mg/d<br>Avoid more than 1 cup daily in patients with severe uncontrolled hypertension |
| Decongestants (eg, phenylephrine, pseudoephedrine) | Use for shortest duration possible and avoid in severe or uncontrolled hypertension<br>Consider alternative therapies (eg, nasal saline, intranasal corticosteroids, antihistamines) as appropriate |
| Herbal supplements (eg, Ma Huang, ephedra, St. John's wort [with MAO inhibitors, yohimbine]) | Avoid use |
| Black licorice[29] | Avoid use |
| NSAIDs; acetaminophen | Avoid systemic NSAIDs when possible<br>Limit acetaminophen to less than 4 g/d[12]<br>Consider alternative analgesics (eg, topical NSAIDs), depending on indication and risk |
| Recreational drugs (eg, "bath salts" [MDPV], cocaine, methamphetamine, etc) | Discontinue or avoid use |
| **Prescription drugs** | |
| Sudden withdrawal of central-acting sympatholytic drugs such as clonidine and tizanidine | Recommend avoiding oral clonidine for treatment of hypertension whenever possible and tapering upon discontinuation[30]; use cyclobenzaprine or other muscle relaxants instead of tizanidine[31] |
| Amphetamines† (eg, amphetamine, methylphenidate dexmethylphenidate, dexamfetamine, lisdexamfetamine, dextroamphetamine) | Discontinue or decrease dose<br>Consider behavioral therapies or nonstimulants (such as guanfacine) for ADHD[32] |
| Antidepressants† (eg, MAOIs, SNRIs, TCAs) | Consider alternative agents (eg, SSRIs) depending on indication<br>Avoid tyramine-containing foods with MAOIs |
| Atypical antipsychotics† (eg, risperidone, olanzapine)[33,34] | Discontinue or limit use when possible<br>Consider behavior therapy where appropriate<br>Recommend lifestyle modification (Section 5.1 "Lifestyle and Psychosocial Approaches")<br>Consider alternative agents associated with lower risk of weight gain, diabetes, and dyslipidemia |
| Immunosuppressants† (eg, cyclosporine) | Consider converting to tacrolimus, which may be associated with fewer effects on BP |

| | |
|---|---|
| Immunosuppressants† (eg, cyclosporine) | Consider converting to tacrolimus, which may be associated with fewer effects on BP |
| Oral contraceptives† | Use low-dose (eg, 20-30 mcg ethinyl estradiol) agents or a progestin-only form of contraception, or consider alternative forms of birth control where appropriate (eg, barrier, abstinence, nonhormonal IUD)<br>Avoid use in women with uncontrolled hypertension[35] |
| Systemic corticosteroids† (eg, dexamethasone, fludrocortisone, methylprednisolone, prednisone, prednisolone) | Avoid or limit use when possible<br>Consider alternative modes of administration (eg, inhaled, topical) when feasible |
| Angiogenesis inhibitor† (eg, bevacizumab) and tyrosine kinase inhibitors (eg, sunitinib, sorafenib) | Avoid or limit use when possible |
| Androgen deprivation therapy† such as CYP 17 inhibitors (eg, abiraterone, orteronel) or androgen receptor antagonist (eg, enzalutamide)[36] | Avoid or limit use when possible<br>Consider alternative chemotherapy |

- Renal artery stenosis refers to a narrowing of the renal artery that can result in a hemodynamically significant **restriction of blood flow,** usually by **>75%.**

- **Atherosclerotic disease (90%)** is the most common cause of renal artery stenosis.
- **Atherosclerotic renovascular disease** may be present in **14% to 40%** of adults with hypertension; however, only a small fraction **(0.1%-5%)** is considered to be **hemodynamically significant** to result in renovascular hypertension.

# Recommendations for Renal Artery Stenosis

| COR | LOE | Recommendations |
|---|---|---|
| 1 | A | 1. In adults with hypertension and atherosclerotic renal artery stenosis, medical therapy is recommended to reduce kidney and CVD morbidity and mortality.[1–3] |
| 2a | C-EO | for whom medical management has failed (eg, resistant hypertension, worsening kidney function, and/or acute HF), it is reasonable to refer patients for revascularization.<br>artery angioplasty and/or stent placement. |
| 2b | C-LD | 3. Fibromuscular dysplasia, it may be reasonable to refer patients for revascularization<br>for revascularization by percutaneous renal artery angioplasty.[4] |

# Recommendations for OSA

| COR | LOE | Recommendations |
|---|---|---|
| **2a** | **B-R** | 1. In adults with hypertension and OSA who are overweight or obese, weight loss interventions when combined with continuous positive airway pressure (CPAP) treatment can be effective in reducing SBP.[1] |
| **2a** | **B-R** | 2. In adults with resistant hypertension and moderate-to-severe OSA, CPAP treatment can be useful in reducing BP.[2,3] |

- OSA is a chronic condition characterized by recurring upper airway obstruction during sleep, resulting in hypoxia and disrupted sleep.
- **Moderate to severe OSA** is associated with an increased risk of **hypertension**, **CVD events**, and **mortality.**
- **Antihypertensive** medications can treat hypertension in adults with OSA.

- **Weight loss** in conjunction with **CPAP therapy** can reduce BP levels in adults with OSA who are overweight or obese.

- A meta-analysis examining the impact of weight loss interventions on BP in adults with OSA demonstrated small effects on SBP (-1.86 mm Hg; 95% CI: -3.57 to -0.15 mm Hg) and DBP (-2.07mm Hg; 95% CI: -3.79 to -0.35 mm Hg).

- However, **weight loss interventions when combined with CPAP** therapy have been shown to **lower SBP by 8 mmHg** in adults with moderate-to-severe OSA.

- Recent data from **SURMOUNT OSA** (**Tirzepatide** for theTreatment of OSA) demonstrated that tirzepatide versus placebo was associated with a reduction in BP at 48 weeks, a prespecified key secondary endpoint, among adults with moderate-to-severe OSA and obesity.
- For adults **not on CPAP** therapy, the estimated treatment difference for **SBP was -7.6mm Hg** (95% CI: -10.5 to -4.8 mm Hg) and for **DBP** was -2.8 mm Hg (95% CI: -5.0 to -0.6 mmHg),
- whereas for adults **on CPAP** therapy the estimated treatment difference for **SBP was -3.7 mmHg** (95% CI: -6.8 to -0.7 mm Hg) and for **DBP was-1.1 mm Hg** (95% CI: -3.2 to 1.0 mm Hg).

- Several RCTs have demonstrated that short-term treatment with **CPAP** can reduce **high office BP and ambulatory BP by 2 to5 mm Hg**,including among individuals with resistant hypertension.
- Data from the **HIPARCO-2** (Long-Term Effect of CPAP on BP in Patients With Resistant Hypertension) study demonstrate that participants with OSA and **resistant hypertension adherent to CPAP** therapy (**4 hours/night**) compared with non-adherent CPAP participants had statistically significant decreases in mean 24-hour ABPM, including **night time SBP and DBP (-5.5 and -4.9 mm Hg**, respectively) over a 59-month follow-up period.

# Prevention strategies

- The etiology of primary (previously termed essential) hypertension is a complex interplay of genetics, lifestyle choices, and chronic stress.

- Lifestyle and Psychosocial Approaches are useful in primordial prevention of hypertension.

# Recommendations for Lifestyle and Psychosocial Approaches

| COR | LOE | Recommendations |
|---|---|---|
| **Weight** | | |
| 1 | A | 1. at least 5% of body weight reduction ight 5% of evated BP and hypertension.[1–9] |
| **Diet and Nutrients** | | |
| 1 | A | 2. In adults w , a heart-healthy ea ASH eating plan, is rec reat elevated BP and hy |
| 1 | A | 3. In adults of dietary <2300 m <1500 m hyperten dietary sodium intake* is recommended to<2300 mg/d, moving toward an ideal limit <1500 mg/d of |

DASH eating plan

| COR | LOE | Recommendations |
|---|---|---|
| 2a | A | 4. In adults with or without hypertension, potassium-based salt substitutes† can be useful to pre…nsion, par…ke is related mostly to food preparation or flavoring at home, except in the presence of CKD or use of drugs that reduce potassium excretion where monitoring of serum potassium levels is indicated.‡[20–24] |
| 1 | A | 5. In adults with elevated BP or hypertension, moderate potassium supplementation,§ ideally from dietary sources die…r tre… the…uce potassium excretion where monitoring of serum potassium levels is indicated.‡ [25–27] |
| **Alcohol** | | |
| 1 | A | 6. Adults with or without hypertension who currently consume alcohol should be advised to pursue a recommended goal of abstinence, or at least to reduce alcohol intake to ≤1 drink/d for women and ≤2 drinks/d for men to prevent or treat elevated BP and hypertension.‖ [28–31] |

| | | |
|---|---|---|
| **Physical Activity** | | |
| **1** | **A** | 7. In adults with or without hypertension, increasing physical ac… exercise program th… se and/or resistance training, is recommended to prevent or treat elevated BP and hypertension.[1,3,4,14,32–39] |
| **Stress Reduction** | | |
| **2b** | **B-R** | 8. In adults with or without hypertension, stress reductio… al meditation may be reasonable to prevent or treat elevated BP and hypertension, as an adjunct to lifestyle or medication interventions.[7,8,14,40] |
| **2b** | **B-R** | 9. In adults with or without hypertension, other forms of stress management, such as breathing control techniques or yoga, may be reasonable to prevent or treat elevated BP and hypertension, as an adjunct to lifestyle or medication interventions.[14,41,42] |

aerobic exercise and/or resistance training

meditation

## Table 12. Lifestyle and Stress Reduction Interventions to Lower Blood Pressure

| Intervention | Target/Biomarker | Evidence-Based Goals | Approximate Mean Change in SBP (mm Hg)* | | References |
|---|---|---|---|---|---|
| | | | With Hypertension | Without Hypertension | |
| Weight loss | Body weight or BMI | Aim for sustained ≥5% reduction in body weight or ≥3 kg/m² reduction in BMI; expect about 1 mm Hg reduction for every 1-kg reduction in body weight | −6 to −8 | −3 to −5 | 2,6,14,52 |
| Heart-healthy diet | DASH eating pattern | Consume a diet rich in fruits, vegetables, whole grains, and low-fat dairy products, with reduced content of saturated and total fat | −5 to −8 | −3 to −7 | 13–15,64,120 |
| Reduced intake of sodium | Dietary sodium intake; 24-h urinary sodium | Optimal goal is <2300 mg/d, but aim for an ideal limit of <1500 mg/d | −6 to −8 | −1 to −4 | 16–18,79,120,121 |
| Use of salt substitute | Replace cooking/table salt (100% sodium chloride) with salt substitute (25%-30% potassium chloride, 65%-75% sodium chloride, and 0%-10% flavoring agents); 24-h urinary sodium and potassium | Reduce dietary sodium intake as above | −5 to −7 | −5 | 20–22,93 |
| Enhanced intake of potassium | Dietary potassium intake; 24-h urinary potassium | Aim for 3500-5000 mg/d, ideally by consumption of a diet rich in potassium; or alternative use of moderate-dose pharmacological potassium supplementation (<80 mmol) | −6 | −3 to −6 | 25–27 |
| Reduced alcohol intake | Alcohol consumption | Optimal goal is abstinence for all adults for best health outcomes; in patients who consume alcohol, aim for >50% reduction in daily intake to no more than 2 drinks/d in men or 1 drink/d in women | −4 to −6 | −3 | 29 |

| | | | | | |
|---|---|---|---|---|---|
| Exercise | Aerobic exercise | 90-150 min/wk<br>65%-75% heart rate reserve | −4 to −8 | −2 to −7 | 14,33,36,120,122 |
| | Dynamic resistance | 90-150 min/wk<br>50%-80% 1 rep maximum<br>6 exercises, 3 sets/exercise, 10 repetitions/set | −2 to −7 | −2 to −5 | 33,36,106,107 |
| | Isometric resistance | 4 × 2 min (hand grip), 1 min rest between exercises, 30%-40% maximum voluntary contraction, 3 sessions/wk | −5 to −10 | −4 to −6 | 14,32,33,36,109,110 |
| Meditation | Transcendental meditation | Training by a professional, followed by 2 × 20 min sessions/d while seated comfortably with eyes closed | −5 to −7 | −5 | 14,119 |
| Breathing control | Slowing respiration | Device-guided session to decrease respiration to <10 breaths/min for 15 min/d | −5 | −5 | 14 |

- A Bayesian network meta-analysis assessed thecomparative effectiveness of 22 lifestyle and stress reduction strategies for BP lowering.

- The **DASH eating plan ranked as the most effective** intervention for BP lowering, followed in order by **aerobic exercise, isometric resistance** training, **low-sodium/high-potassium salt** interventions, and comprehensive lifestyle interventions.

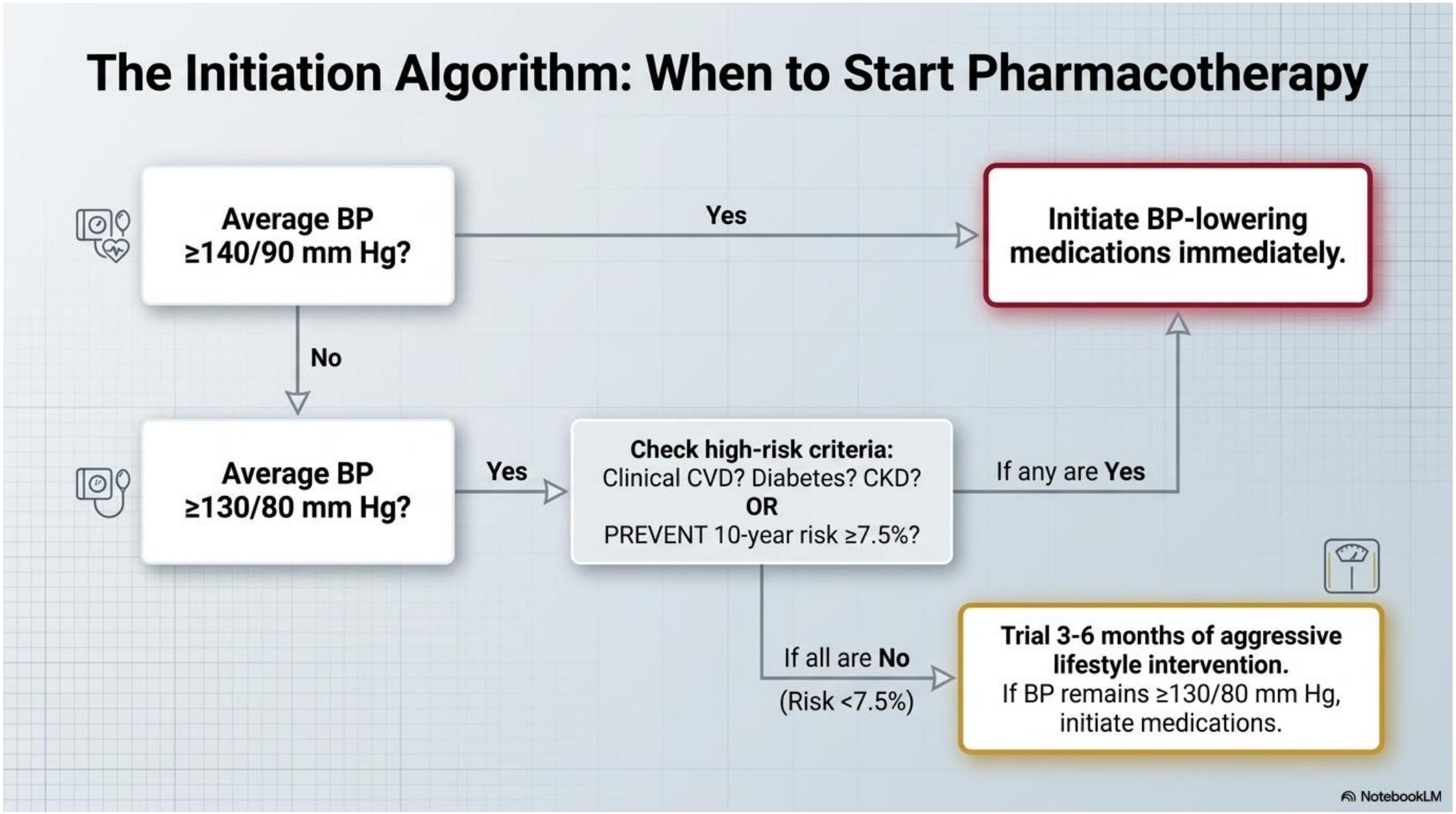
- In general, there is a reduction in BP of approximately **1/1 mm Hg(systolic/diastolic**) for **each 1 kg** (2.2 lbs) of weightloss

- . Weight reduction **5% of body weight or 3kg/m2 of BMI**, compared with lesser amounts, produces greater BP lowering in patients with and without hypertension

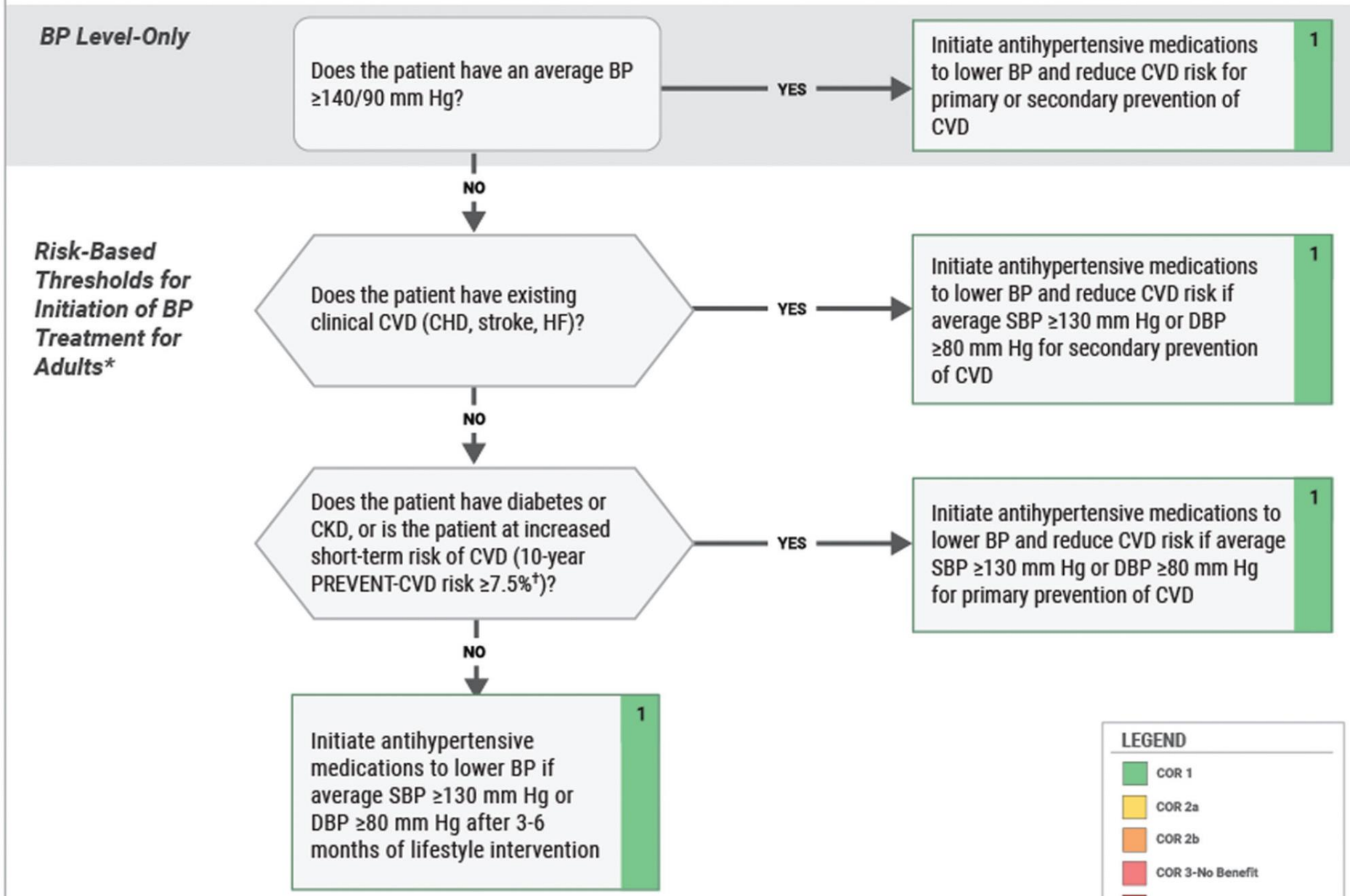
- In the largest trial to date, **20 995adults in China**, with either a history of stroke or age 60 years and uncontrolled BP, were enrolled in a cluster-randomized trial comparing a salt substitute (75% sodium chloride/25% potassium chloride) with regular salt.

- Use of the **salt substitute** was associated with **SBP reduction by 3.3** mm Hg and significant relative **reductions in stroke, MACE,** and **all-cause mortality** of **12% to 14%,** with no increase in risk for hyperkalemia.

# The Initiation Algorithm: When to Start Pharmacotherapy



# Use of Risk-Based Thresholds for Initiation of BP Treatment in Adults




2025 High Blood Pressure

© 2025 by the American Heart Association, Inc., and the American College of Cardiology Foundation

## *5.2.3. Initial Medication Selection for Treatment of Primary Hypertension*

**Recommendation for Initial Medication Selection for Treatment of Primary Hypertension**
**Referenced studies that support the recommendation are summarized in the Evidence Table.**

| COR | LOE | Recommendation |
|---|---|---|
| 1 | A | 1. For adults initiating antihypertensive drug therapy, thiazide-type diuretics, long-acting dihydropyridine CCB, and ACEi or ARB are recommended as first-line therapy to prevent CVD.[1,2] |

# The First-Line Arsenal: Four Core Classes

**Thiazide-Type Diuretics**
(e.g., Chlorthalidone, HCTZ, Indapamide)

***Pearl:*** *Chlorthalidone preferred for longer* half–life/potency. *Monitor for hyponatremia and hypokalemia.*

**Calcium Channel Blockers (CCB)**
Dihydropyridines (e.g., Amlodipine)

***Pearl:*** *Highly effective; watch for dose-related lower extremity edema.*

**ACE Inhibitors (ACEi)**
(e.g., Lisinopril, Benazepril)

***Pearl:*** *Highly protective in CKD. Watch for hyperkalemia and cough.*

**Angiotensin Receptor Blockers (ARB)**
(e.g., Losartan, Valsartan)

***Pearl:*** *Excellent alternative if ACEi causes cough.*

**Class 3: Harm** — NEVER use an ACEi, ARB, and/or direct renin inhibitor in combination due to increased risk of AKI and hyperkalemia.

NotebookLM

## 5.2.4. Choice of Initial Monotherapy Versus Initial Combination Drug Therapy

**Recommendations for Choice of Initial Monotherapy Versus Initial Combination Drug Therapy**
**Referenced studies that support the recommendations are summarized in the Evidence Table.**

| COR | LOE | Recommendations |
|---|---|---|
| 1 | B-R | 1. In adults with stage 2 hypertension (SBP ≥ 140 mm Hg and DBP ≥90 mm Hg), initiation of antihypertensive drug therapy with 2 first-line agents of different classes, ideally in a single-pill combination (SPC), is recommended to improve BP control and adherence.[1–6] |
| 2a | C-EO | 2. In adults with stage 1 hypertension (SBP 130-139 mm Hg and DBP 80-89 mm Hg), initiation of antihypertensive drug therapy with a single first-line antihypertensive drug is reasonable, with dosage titration and sequential addition of other agents as needed to achieve BP control. |
| 3: Harm | A | 3. In adults with hypertension, simultaneous use of an ACEi, ARB, and/or renin inhibitor in combination is not recommended due to the potential for harm.[7–9] |

| | | | | |
|---|---|---|---|---|
| Beta blockers–cardioselective | Atenolol | 25-100 | 2 | Beta blockers are not recommended as first-line agents unless the patient has CHD or HF.<br>These are preferred in patients with bronchospastic airway disease requiring a beta blocker.<br>Bisoprolol and metoprolol succinate are preferred in patients with HFrEF.<br>Avoid abrupt cessation. |
| | Betaxolol | 5-20 | 1 | |
| | Bisoprolol | 2.5-10 | 1 | |
| | Metoprolol tartrate | 100-200 | 2 | |
| | Metoprolol succinate | 50-200 | 1 | |
| Beta blockers–cardioselective and vasodilatory | Nebivolol | 5-40 | 1 | Nebivolol induces nitric oxide-induced vasodilation.<br>Avoid abrupt cessation. |
| Beta blockers–noncardioselective | Nadolol | 40-120 | 1 | Avoid use in patients with reactive airways disease.<br>Avoid abrupt cessation. |
| | Propranolol IR | 80-160 | 2 | |
| | Propranolol LA | 80-160 | 1 | |
| Beta blockers–intrinsic sympathomimetic activity | Acebutolol | 200-800 | 2 | Generally avoid, especially in patients with CHD or HF.<br>Avoid abrupt cessation. |
| | Penbutolol | 10-40 | 1 | |
| | Pindolol | 10-60 | 2 | |
| Combined alpha and beta blockers | Carvedilol | 12.5-50 | 2 | Use of carvedilol is preferred in patients with HFrEF.<br>Avoid abrupt cessation. |
| | Carvedilol phosphate | 20-80 | 1 | |
| | Labetalol | 200-1200 | 2 | |
| Direct renin inhibitor | Aliskiren | 150-300 | 1 | Do not use in combination with ACEi or ARB.<br>Aliskiren is very long acting.<br>There is an increased risk of hyperkalemia in CKD or in those on K+ supplements or K+-sparing drugs.<br>Aliskiren may cause acute renal failure in patients with severe bilateral renal artery stenosis.<br>Avoid use in pregnancy. |
| Alpha-1 blockers | Doxazosin | 1-16 | 1 | These are associated with orthostatic hypotension, especially in older adults with a greater BP drop with first dose effect.<br>These may be considered a second-line agent in patients |
| | Prazosin | 2-20 | 2 or 3 | |
| | Terazosin | 1-20 | 1 or 2 | |

**Table 13. Continued**

| Class | Drug | Usual Dose, Range (mg/d)* | Daily Frequency | Comments |
|---|---|---|---|---|
| Central alpha-2-agonist and other centrally acting drugs | Clonidine oral | 0.1-0.8 | 2 | These are generally reserved as last-line choices because of significant CNS adverse effects, especially in older adults.<br>Avoid abrupt discontinuation of clonidine, which may induce hypertensive crisis.<br>Clonidine must be tapered to avoid rebound hypertension. |
| | Clonidine patch | 0.1-0.3 | 1 weekly | |
| | Methyldopa | 250-1000 | 2 | |
| | Guanfacine | 0.5-2 | 1 | |
| Direct vasodilators | Hydralazine | 100-200 | 2 or 3 | These are associated with sodium and water retention and reflex tachycardia and should be used with a diuretic and beta blocker.<br>Hydralazine is associated with a drug-induced lupus-like syndrome at higher doses.<br>Minoxidil is associated with hirsutism and requires a loop diuretic. Minoxidil can induce pericardial effusion. |
| | Minoxidil | 5-40 | 1-2 | |
| Dual endothelin receptor antagonist | Aprocitentan | 12.5 | 1 | Associated with mild-to-moderate fluid retention usually occurring within the first 4-6 wks of therapy.<br>Indicated as add-on therapy for patients whose BP is not adequately controlled on other antihypertensive medications.<br>Avoid use in pregnancy. |

## 5.2.7. BP Goal for Patients With Hypertension

**Recommendations for BP Goal for Patients With Hypertension**
**Referenced studies that support recommendations are summarized in the Evidence Table.**

| COR | LOE | Recommendations |
|---|---|---|
| 1 | A | 1. In adults with confirmed hypertension who are at increased risk* for CVD, an SBP goal of at least <130 mm Hg, with encouragement to achieve SBP <120 mm Hg, is recommended to reduce the risk of cardiovascular events and total mortality.[1–4] |
| 2b | B-NR | 2. In adults with confirmed hypertension who are not at increased risk* for CVD, an SBP goal of <130 mm Hg, with encouragement to achieve SBP <120 mm Hg, may be reasonable to reduce risk of further elevation of BP.[5] |
| 1 | B-R | 3. In adults with confirmed hypertension who are at increased risk* for CVD, a DBP target of <80 mm Hg is recommended to reduce the risk of cardiovascular events and total mortality.[6] |
| 2b | B-NR | 4. In adults with confirmed hypertension who are not at increased risk* for CVD, a DBP target of <80 mm Hg may be reasonable to reduce the risk of cardiovascular events.[5] |

*Increased risk is defined as a 10-year predicted risk for CVD events of ≥7.5% using PREVENT.

## Table 15. Evidence-Based Strategies for Improving Antihypertensive Medication Adherence

| Evidence-Based Strategies for Improving Antihypertensive Medication Adherence |
|---|
| Dose consolidation |
| Single pill combination rather than separate pills |
| Education/coaching by pharmacists and other health professionals |
| Electronic/home blood pressure monitoring and feedback |
| Integration of patient preferences and values/shared decision-making into management plan |
| Medication synchronization and reminder aids |
| Mindfulness-based stress reduction or counseling for high stress, anxiety, and/or depression |
| Self-management interventions |

Modified with permission from Choudhry et al.[21] Copyright 2022 American Heart Association Inc.

**Table 16. Pharmacokinetic Drug–Drug Interactions With Antihypertensive Medications**

| Blood Pressure Drug | Potential Interacting Drug | Clinical Effect |
|---|---|---|
| **Absorption** | | |
| Thiazide-type diuretics | Cholestyramine | Decreased absorption leading to reduced BP lowering |
| Amlodipine, furosemide, metoprolol, carvedilol, bisoprolol, nebivolol, telmisartan | Potassium binder (patiromer) | Decreased absorption of antihypertensives leading to reduced BP-lowering effects. To mitigate this, administer the antihypertensives at least 3 h before or after taking the potassium binder |
| Furosemide | Potassium binder (sodium zirconium cyclosilicate) | Increased absorption of furosemide due to increased gastric pH leading to increased clinical effects (eg, diuresis or risk of hypokalemia); effect diminished with separation of administration by 2 h |
| Methyldopa | Iron salts | Decreased absorption of methyldopa leading to reduced BP lowering |
| **Metabolism** | | |
| Bisoprolol, carvedilol, metoprolol | CYP2D6 inhibitors (eg, amiodarone, cimetidine, diphenhydramine, fluoxetine, paroxetine, terbinafine) | Increased BB concentration leading to enhanced clinical effects (eg, hypotension and bradycardia) |

| | | |
|---|---|---|
| Diltiazem, verapamil | CYP3A4 inhibitors (eg, clarithromycin, erythromycin itraconazole, ketoconazole) | Increased nondihydropyridine concentration leading to enhanced clinical effects (eg, hypotension and bradycardia) |
| Diltiazem, verapamil | CYP3A4 inducers (eg, carbamazepine, phenobarbital, phenytoin, St. John's Wort, rifampin) | Decreased nondihydropyridine CCB concentration leading to reduced clinical effects (eg, minimization of blood pressure and pulse lowering) |
| CYP3A4 inhibition via amlodipine, verapamil, or diltiazem or other CYP3A4 inhibitors | Tacrolimus, cyclosporine | Increased calcineurin inhibitor concentration leading to increased risk for side effects (eg, renal impairment) |
| | Dabigatran, rivaroxaban | Increased concentration leading to increased risk for bleeding |
| | Atorvastatin, simvastatin | Increased statin concentration leading to increased risk for side effects (eg, myopathy) |
| | Colchicine | Increased colchicine concentration leading to increased risk for adverse effects (eg, neuromuscular toxicity) |
| | Eplerenone | Increased risk of hypotension and hyperkalemia<br>Using a lower dose of eplerenone when combined with diltiazem could be considered a productive interaction, as the inhibition of eplerenone's metabolism might allow for lower doses to be effective, reducing the risk of adverse effects while maintaining efficacy |
| **Elimination** | | |
| Lithium | Thiazide-type diuretics, RAS blockers | Reduced lithium clearance leading to increased lithium toxicity risk |
| **P-glycoprotein (P-gp)** | | |
| Verapamil via P-gp inhibition | Dabigatran | Reduced P-gp efflux of dabigatran leading to increased dabigatran levels, which results in a higher risk of bleeding |
| Verapamil and carvedilol via P-gp inhibition | Digoxin | Reduced P-gp efflux of digoxin leading to increased digoxin levels, resulting in a higher risk of digoxin toxicity |

# Pharmacologic Drug-Drug interactions With Antihypertensive Medications

| Drug Combinations | | Clinical Effect |
|---|---|---|
| **Cautionary interactions** | | |
| Any antihypertensive medication | NSAIDs | Reduced BP lowering via sodium retention |
| | Sympathomimetic (eg, pseudoephedrine, dextroamphetamine) | Reduced BP lowering |
| | Venlafaxine | Reduced BP lowering |
| Nondihydropyridine CCB | Beta blockers | Bradycardia or atrioventricular block |
| ACEi | ARBs | AKI, hyperkalemia |
| | Potassium-sparing diuretics (Spironolactone, eplerenone, triamterene, amiloride) | Hyperkalemia |
| | Sulfamethoxazole/trimethoprim | Hyperkalemia |
| | Potassium supplements | Hyperkalemia |
| | NSAIDs (eg, ibuprofen, naproxen) | AKI |
| Clonidine, methyldopa, guanfacine | CNS depressants (eg, zolpidem, alprazolam) | Sedation |
| Clonidine | Noncardioselective BB (eg, nadolol or propranolol) | Unopposed alpha agonism upon BB withdrawal leading to hypertensive crisis |
| **Advantageous interactions** | | |
| Dihydropyridine CCB | RAS inhibitor | Reduced risk of dihydropyridine CCB-induced lower leg swelling |
| RAS inhibitors | Diuretics | Balanced effects on serum potassium levels with diminished possibility for hypokalemia (with diuretic) or hyperkalemia (with RAASi) |
| RAS inhibitors | Potassium binder | Lowers risk of hyperkalemia from the RAS inhibitor |
| Diuretic | Potassium supplement | Lowers risk of hypokalemia from the diuretic |

## 5.3.1. Diabetes

**Recommendations for Diabetes**
**Referenced studies that support the recommendations are summarized in the Evidence Table.**

| COR | LOE | Recommendations |
|---|---|---|
| 1 | A | 1. In adults with T2D and hypertension, antihypertensive drug treatment should be initiated at an SBP of ≥130 mm Hg with a treatment goal of <130 mm Hg, with encouragement to achieve an SBP <120 mm Hg to reduce CVD morbidity and mortality.[1–5] |
| 1 | C-LD | 2. In adults with T2D and hypertension, antihypertensive drug treatment should be initiated at a DBP of ≥80 mm Hg with a treatment goal of <80 mm Hg to reduce CVD morbidity and mortality.[6] |
| 1 | A | 3. In adults with T2D and hypertension, all first-line classes of antihypertensive agents (ie, thiazide-type diuretics, long-acting CCB, ACEi, and ARB) are useful and effective for BP lowering.[1,7–9] |
| 1 | A | 4. In adults with diabetes and hypertension, ACEi or ARB are recommended in the presence of CKD as identified by eGFR <60 mL/min/1.73 $m^2$ or albuminuria ≥30 mg/g and should be considered when mild albuminuria (<30 mg/g) is present to delay progression of diabetes-related kidney disease.[10–12] |

## 5.3.2. Obesity and Metabolic Syndrome

**Recommendations for Obesity and Metabolic Syndrome**
**Referenced studies that support the recommendations are summarized in the Evidence Table.**

| COR | LOE | Recommendations |
|---|---|---|
| 2b | B-R | 1. In adults with hypertension who also have overweight or obesity with a BMI ≥27 kg/m$^2$, incretin mimetics (eg, GLP-1 receptor agonists) when used for weight management may be effective as an adjunct to lower BP.[1–4] |
| 2b | B-R | 2. In adults with hypertension who have obesity with a BMI ≥35.0 kg/m$^2$, bariatric surgery (when considered for weight loss) in combination with behavioral interventions and antihypertensive therapies may be effective at lowering BP.[5,6] |

## 5.3.4. Prevention of HF in Adults With Hypertension

**Recommendations for the Prevention of HF in Adults With Hypertension**
**References that support the recommendations are summarized in the Evidence Table.**

| COR | LOE | Recommendations |
|---|---|---|
| 1 | B-R | 1. In adults with hypertension, treating SBP to <130 mm Hg is recommended to lower the risk of developing HF.[1–4] |
| 1 | B-NR | 2. In adults with hypertension, treating DBP to <80 mm Hg is recommended to lower the risk of developing HF.[1–5] |

## Table 18. GDMT for Patients With Hypertension and HFrEF

| Drug Class | Notes on Use |
|---|---|
| BB | In patients with HFrEF, even if asymptomatic, use 1 (bisoprolol, carvedilol, metoprolol succinate). soprolol, carvedilol, metoprolol succinate). |
| MRA | In patients with symptomatic HFrEF, spironolactone or ep symptomatic HFrEF, spironolactone or eplerenone mortality if eGFR is >30 mL/min/1.73 $m^2$ and potassium is <5.0 mEq/L. |
| RAASi with ACEi or ARB or ARNi | In patients with HFrEF and NYHA functior functional class II to III symptoms, ARNi morbidity and mortality.<br>When the use of ARNi is not feasible, ACEi or ARB is recommended to reduce morbidity and mortality. |
| SGLT2i | SGLT2i are recommended in patients with symp SGLT2i are recommended in patients with symptomatic HFrEF of the presence of type 2 diabetes. |
| **Additional GDMT to be added as indicated** | |
| Hydralazine and isosorbide dinitrate | For pa Black with NYHA functional **class III to IV HFrEF** who are receiving **optimal medical therapy**, binati<br>In pat patients with current or previous symptomatic HFrEF who **cannot be given first-line agents**,the becau combination of hydralazine and isosorbide dinitrate<br>reduce morbidity and mortality. |

## 5.3.8. Hypertension Treatment in Patients With CKD

**Recommendations for Hypertension Treatment in Patients With CKD**
**References that support recommendations are summarized in the Evidence Table.**

| COR | LOE | Recommendations |
|---|---|---|
| 1 | A | 1. For adults with hypertension and CKD as eGFR <60 mL/min/1.73 m2 or albuminuria ≥30 mg albumin/g creatinine, treatment should target an SBP goal of <130 mm Hg to decrease all-cause mortality.[1–3] |
| 1 | B-R | 2. For adults with hypertension and CKD as identifi[ed] with albumi[nuria] treated with ACEi or ARB but not both) is recommended to decrease CVD and delay progression of kidney disease.[4,5] RAASi (either with ACEi or ARB but not both) |

# Navigating Comorbidities: Targeted Therapy Pathways

## Chronic Kidney Disease (CKD)

**Threshold:**
eGFR <60 mL/min/1.73 m² or albuminuria ≥30 mg/g

**Action:** Use an ACEi or ARB to delay kidney disease progression.

**Clinical Pearl:**
Expect and tolerate an initial eGFR dip of up to 30% upon RAASi initiation; do not discontinue unless dip is persistently >30%.

## Diabetes (T2D)

**Goal:**
SBP <130 mm Hg / DBP <80 mm Hg

**Action:**
All four first-line classes are effective. SGLT2i and GLP-1 agonists provide concomitant metabolic and BP benefits.

## Heart Failure (HF)

**HFrEF:**
Maximize HF Guideline-Directed Medical Therapy (GDMT). Avoid non-dihydropyridine CCBs (diltiazem/verapamil) due to negative inotropic effects.

**HFpEF:**
Appropriate use of diuretics is crucial; MRAs and SGLT2i reduce hospitalizations.

# The Universal Target: Reaching <130/80 mm Hg

### The Primary Goal

An **SBP of <130 mm Hg** and **DBP of <80 mm Hg** is the **universal target** to reduce cardiovascular events and total mortality for patients at increased CVD risk.

### The Intensive Push

Encourage achieving **SBP <120 mm Hg** when tolerated.

### The Evidence (SPRINT & BPROAD)

Targeting **SBP <120** vs **<140 mm Hg** yields significant reductions in MACE, Heart Failure, and all-cause mortality across general and diabetic populations.

### Cautionary Note

Careful monitoring is required for hypotension, electrolyte abnormalities, and eGFR changes during intensive therapy, particularly in older/frail adults.

NotebookLM

## 5.3.9.1. Acute Intracerebral Hemorrhage

| Recommendations for Acute Intracerebral Hemorrhage | | |
|---|---|---|
| **COR** | **LOE** | **Recommendations** |
| **2a** | **A** | 1. For adult patients with acute spontaneous intracerebral hemorrhage (ICH) who present with SBP 150 and 220 mm Hg, it can be beneficial to immediately lower SBP to 130 to <140 mm Hg for at least 7 days after outcomes but stop antihypertensive medications if SBP <130 mm Hg.[1–3] |
| **2a** | **B-NR** | 2. In adults with acute spontaneous ICH requiring BP lowering, careful titration to ensure smooth, nonlabile, and sustained control of BP, avoiding peaks and large variability beneficial for improving functional outcomes. |
| **3: Harm** | **B-NR** | 3. should not be lowered below 130 mm Hg no be lowered below 130 mm Hg to reduce adverse events.[5–7] |

## 5.3.9.2. Acute Ischemic Stroke

**Recommendations for Acute Ischemic Stroke**
**References that support recommendations are summarized in the Evidence Table.**

| COR | LOE | Recommendations |
|---|---|---|
| 1 | C-LD | 1. In patient … and hypo… systemic … organ function.[1–3] … on … |
| 1 | B-NR | IV thrombolytics should have their BP lowered to SBP <185 mm Hgand DBP <110 mm Hg before IV thrombolytic therapy is initiated and should be maintained below 180/105 mm Hg for at least the first 24 hours |
| 2a | B-NR | 3. In patients who undergo endovascular treatment, it … m… pr… ou… |
| 2b | C-LD | 4. In patients with BP of ≥220/120 mm Hg who did not receive IV thrombolytic or endovascular |

Hypotension and hypovolemia should be corrected

patients who undergo endovascular treatment,
it is reasonable to maintain the BP at ≤180/105
mm Hg during and for 24 hours after the
procedure

BP **of ≥220/120 mm** Hg who did not receive IV thrombolytic or endovascular treatment and have no comorbid conditions
requiring acute antihypertensive treatment, it mightbe reasonable
to **lower BP by 15% during the first24 hours** after onset of stroke

| Recommendations for Acute Ischemic Stroke (Continued) | | |
|---|---|---|
| **COR** | **LOE** | **Recommendations** |
| **3: No Benefit** | **A** | 5. In patients with ~~BP <220/120~~ mm Hg who do not receive IV thrombolysis or endovascular treatment and do not have a comorbid condition requiring urgent antihypertensive treatment, initiating or reinitiating treatment of hypertension within the first 48 to 72 hours after an acute ischemic stroke is not effective to prevent death or disability.[8–11] |
| **3: Harm** | **A** | undergoing successful brain reperfusion with endovascular treatment for a large vessel occlusion, lowering SBP <140 mm Hg within the first 24 to 72 hours after reperfusion can worsen long-term functional outcome |

## 5.3.9.3. Secondary Stroke Prevention

**Recommendations for Secondary Stroke Prevention**
**References that support recommendations are summarized in the Evidence Table.**

| COR | LOE | Recommendations |
|---|---|---|
| 1 | A | 1. In patients with hypertension who have experienced an ischemic stroke, transient ischemic attack (TIA), or ICH, treatment with a thiazide-type diuretic, ACEi, or ARB is recommended for lowering BP and reducing recurrent stroke and ICH risk.[1–3] |
| 1 | B-R | 2. In patients with hypertension who have experienced who have experienced an ischemic stroke, TIA, or ICH, an office SBP/DBP goal of <130/80 mm Hg is recommended |
| 2a | B-R | 3. In patients with no history of hypertension who have experienced an ischemic stroke, TIA, or ICH and have an average office SBP/DBP of ≥130/80 mm Hg, antihypertensive medication treatment can be beneficial to reduce the risk of recurrent stroke, ICH, and other vascular events.[5–7] |

## 5.3.9.4. Mild Cognitive Impairment and Dementia

| Recommendation for Prevention of Mild Cognitive Impairment and Dementia<br>Referenced studies that support the recommendation are summarized in the Evidence Table. | | |
|---|---|---|
| **COR** | **LOE** | **Recommendation** |
| **1** | **A** | 1. In adults with hypertension, a goal of <130 mm Hg SBP is recommended to prevent mild cognitive impairment and dementia.[1–5] |

**Recommendations for Plan of Care for Hypertension**
**Referenced studies that support the recommendations are summarized in the Evidence Table.**

| COR | LOE | Recommendations |
|---|---|---|
| **Team-Based Care** | | |
| 1 | A | 1. For adults w team-based achieve and maintain BP control.[1–4] |
| 1 | C-LD | 2. |
| **Framework in Clinical** | | |
| 1 | B-N | |
| **Follow-Up After Initial BP Evaluation and Initiation of Antihypertensive Therapy** | | |
| 1 | B-R | 4. Adults with uncontrolled hypertension placed on new follo and until |
| **Health Information Technology** | | |
| 1 | | 5. For adults with uncontrolled hypertension, |

team-based care approach

uncontrolled hypertension, an evidence-based care plan utilizing HBPM, and team-based care

Accurate BP measurement, prompt treatment, Patient engagement, and ongoing review of HBPM

follow-up evaluations for **medication adherence** and response to treatment at **monthly intervals**

**health information technology (HIT**) by synchronous (eg, phone, video call) or asynchronous (eg, text, e-mail) communication is beneficial in improving BP control, access to care, and adherence to standards of care

# Orthostatic hypotension

## 6. COMPLICATIONS OF MANAGEMENT

### 6.1. Management of OH

**Recommendations for Management of OH**
**Referenced studies that support the recommendations are summarized in the Evidence Table.**

| COR | LOE | Recommendations |
|---|---|---|
| 1 | A | 1. In adults with hypertension, improved BP control is recommended to reduce the risk for OH.[1–4] |
| 2a | A | 2. In adult with as SBP <130 mm Hg is reasonable due to increased CVD and mortality benefit.[3,5] |
| 2a | B-R | initiating treatment or adding medication with a goal of SBP <130 mmHg, assessment for symptomatic OH is reasonable |

asymptomatic OH, treatment with a goal of SBP <130 mm Hg

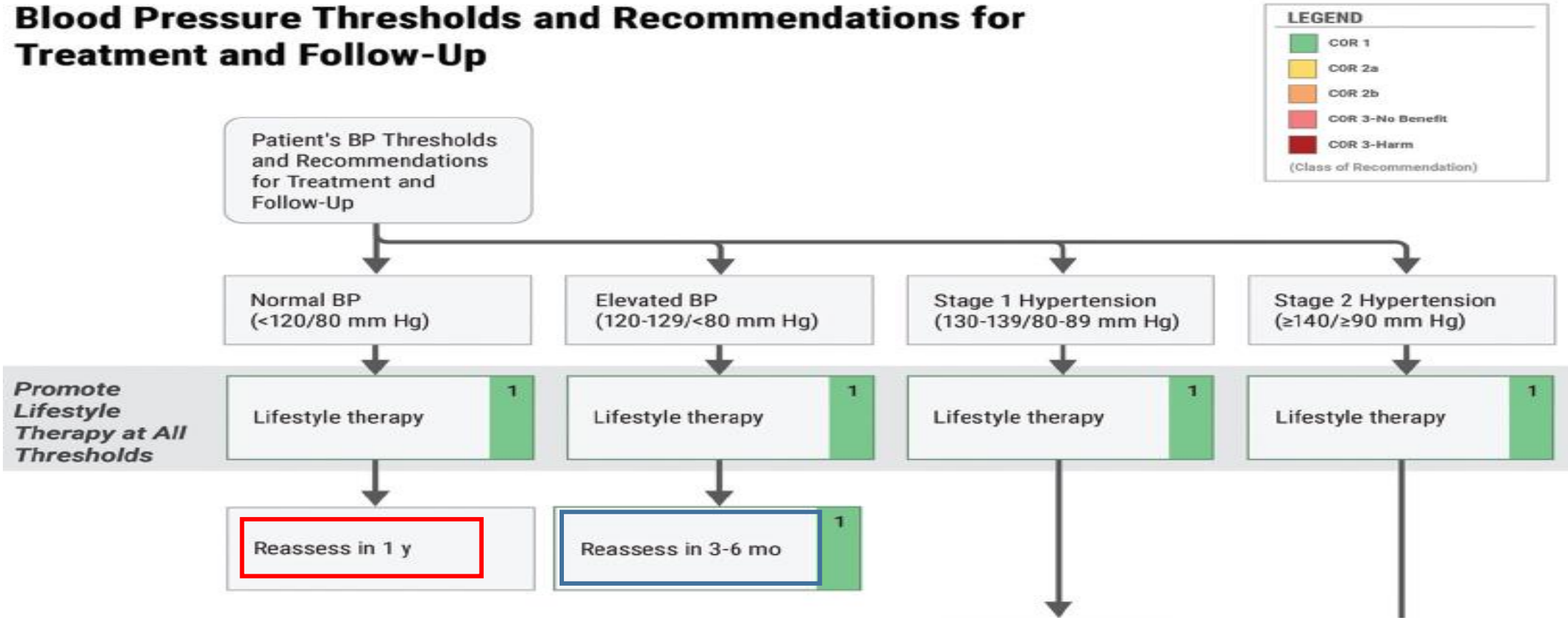
# 6.4. Patients Scheduled for Surgical Procedures

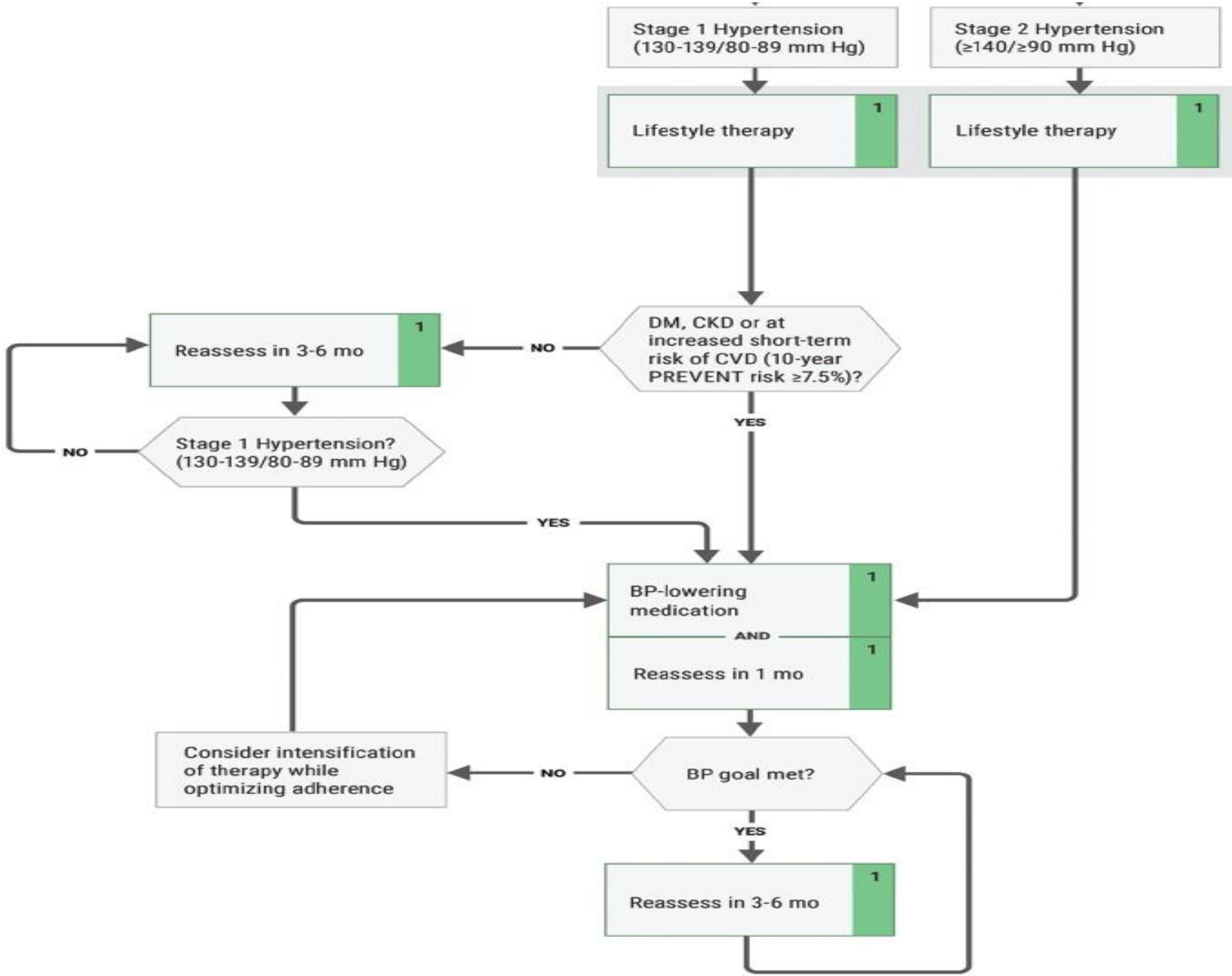
**Recommendations for Patients Scheduled for Surgical Procedures**
**Referenced studies that support the recommendations are summarized in the Evidence Table.**

| COR | LOE | Recommendations |
|---|---|---|
| 1 | B-NR | 1. In patients with hypertension scheduled for major surgery who have been on BBs chronically, BBs should be continued ...tive period to assist with BP control. |
| 2a | C-EO | 2. In patients with hypertension scheduled for e... to continue most medications ...ble to continue m... throughout the perioperative period. |
| 2b | B-R | 3. In patients with hypertension scheduled for major surgery discontinuation of ACEi or ARB preoperatively may be considered ...pera-tively m... on during surgery.[6–10] |

| Recommendations for Patients Scheduled for Surgical Procedures (Continued) | | |
|---|---|---|
| **COR** | **LOE** | **Recommendations** |
| **2b** | **C-LD** | 4. In patients scheduled for elective major surgery with SBP ≥180 mm Hg or DBP ≥110 mm Hg, deferring surgery patients to minimize perioperative complications.[11–13] |
| **3: Harm** | **B-NR** | 5. In abrupt preoperative discontinuation of BB or clonidine may result in rebound hypertension and is potentially harmful.[14] |
| **3: Harm** | **B-R** | 6. For BB should not be started on the day of surgery in BB-naïve patients of surgery in BB-naïve patients because of increased risk of postoperative mortality.[4,15,16] |

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




Stage 1 Hypertension (130-139/80-89 mm Hg)
Stage 2 Hypertension (≥140/≥90 mm Hg)
Lifestyle therapy
1
Lifestyle therapy
1
DM, CKD or at increased short-term risk of CVD (10-year PREVENT risk ≥7.5%)?
NO
Reassess in 3-6 mo
1
YES
Stage 1 Hypertension? (130-139/80-89 mm Hg)
NO
YES
BP-lowering medication
1
AND
Reassess in 1 mo
1
BP goal met?
NO
Consider intensification of therapy while optimizing adherence
YES
Reassess in 3-6 mo
1

# The American Heart Association PREVENT™ Online Calculator

About the PREVENT Equations | Online Calculator

CVD | ASCVD | Heart Failure

**Sex***
(•) Male ( ) Female

**Age (years)***
30-79

**SBP (mmHg)***
90-200

**Total Cholesterol (mg/dL)***
130-320

**HDL Cholesterol (mg/dL)***
20-100

**eGFR (mL/min/1.73m$^2$)***
15-140

**BMI (kg/m$^2$)***
18.5-39.9

**Diabetes**
Any history of diabetes.
(•) No ( ) Yes

**Current Smoking**
Any cigarette use within the last 30 days
(•) No ( ) Yes

**Lipid-lowering medication**
Current use of statin medication to lower cholesterol
(•) No ( ) Yes

**Anti-hypertensive medication**
Current use of any medication for hypertension
(•) No ( ) Yes

**The following three predictors are optional for further personalization of risk assessment. When they are clinically indicated or available,**

If available or indicated, select "Yes" and enter the value.

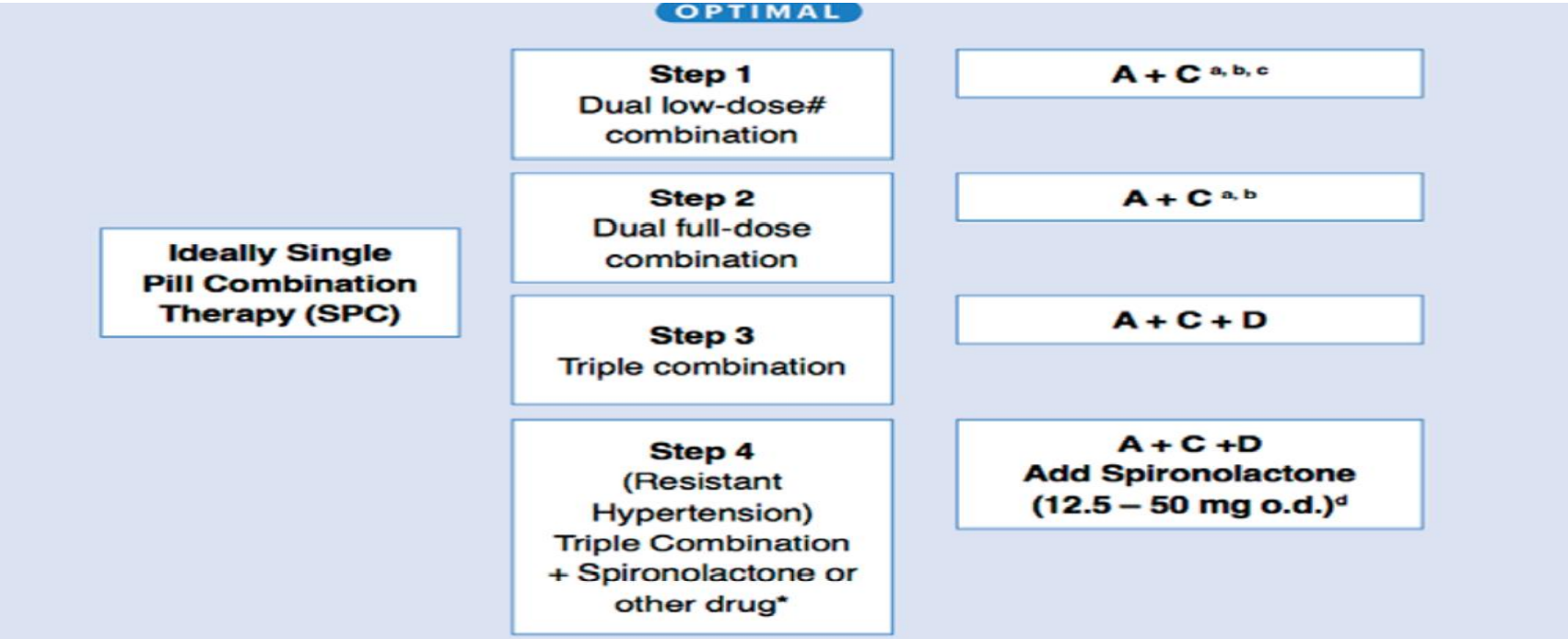
**UACR (mg/g)**
UACR is clinically indicated for individuals with chronic kidney disease, diabetes, or hypertension
(•) No ( ) Yes

**HbA1C**
HbA1c is clinically indicated for individuals with diabetes, prediabetes, overweight, or obesity, or those with history of gestational diabetes
(•) No ( ) Yes

**Zip Code**
valid 5-digit zip code is needed to estimate social deprivation index [SDI]
(•) No ( ) Yes

Calculate | Reset

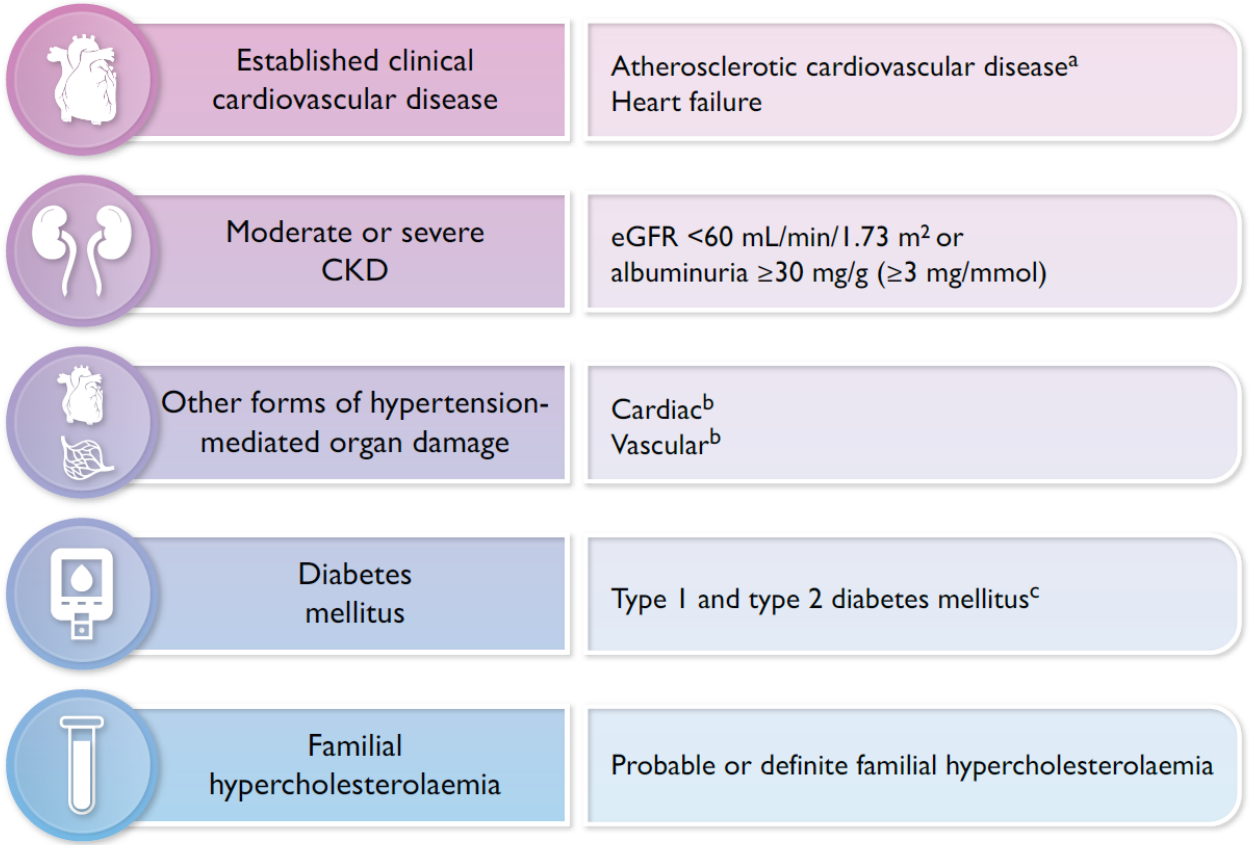
# 2020 ISH Global Hypertension Practice Guideline




**a)** Consider monotherapy in low risk grade 1 hypertension or in very old (≥80 yrs) or frailer patients.
**b)** Consider A + D in post-stroke, very elderly, incipient HF or CCB intolerance.
**c)** Consider A + C or C + D in black patients.
**d)** Caution with spironolactone or other potassium sparing diuretics when estimated GFR <45 ml/min/1.73m² or $K^+$ >4.5 mmol/L.

**A** = ACE-Inhibitor or ARB (Angiotensin Receptor Blocker)
**C** = DHP-CCB (Dihydropyridine -Calcium Channel Blocker)
**D** = Thiazide-like diuretic
**Supportive references:** A + C,[69,70] Spironolactone,[71] Alpha-blocker,[72] C + D[73].
* Alternatives include: Amiloride, doxazosin, eplerenone, clonidine or beta-blocker.

## Sufficiently high cardiovascular risk conditions that warrant blood pressure-lowering treatment among adults with **elevated blood pressure**.



# Risk modifiers

## Sex-specific modifiers (Class IIa)


Gestational diabetes


Gestational hypertension


Pre-eclampsia


Pre-term delivery


One or more stillbirth


Recurrent miscarriage

## Shared modifiers (Class IIa)


High-risk ethnicity

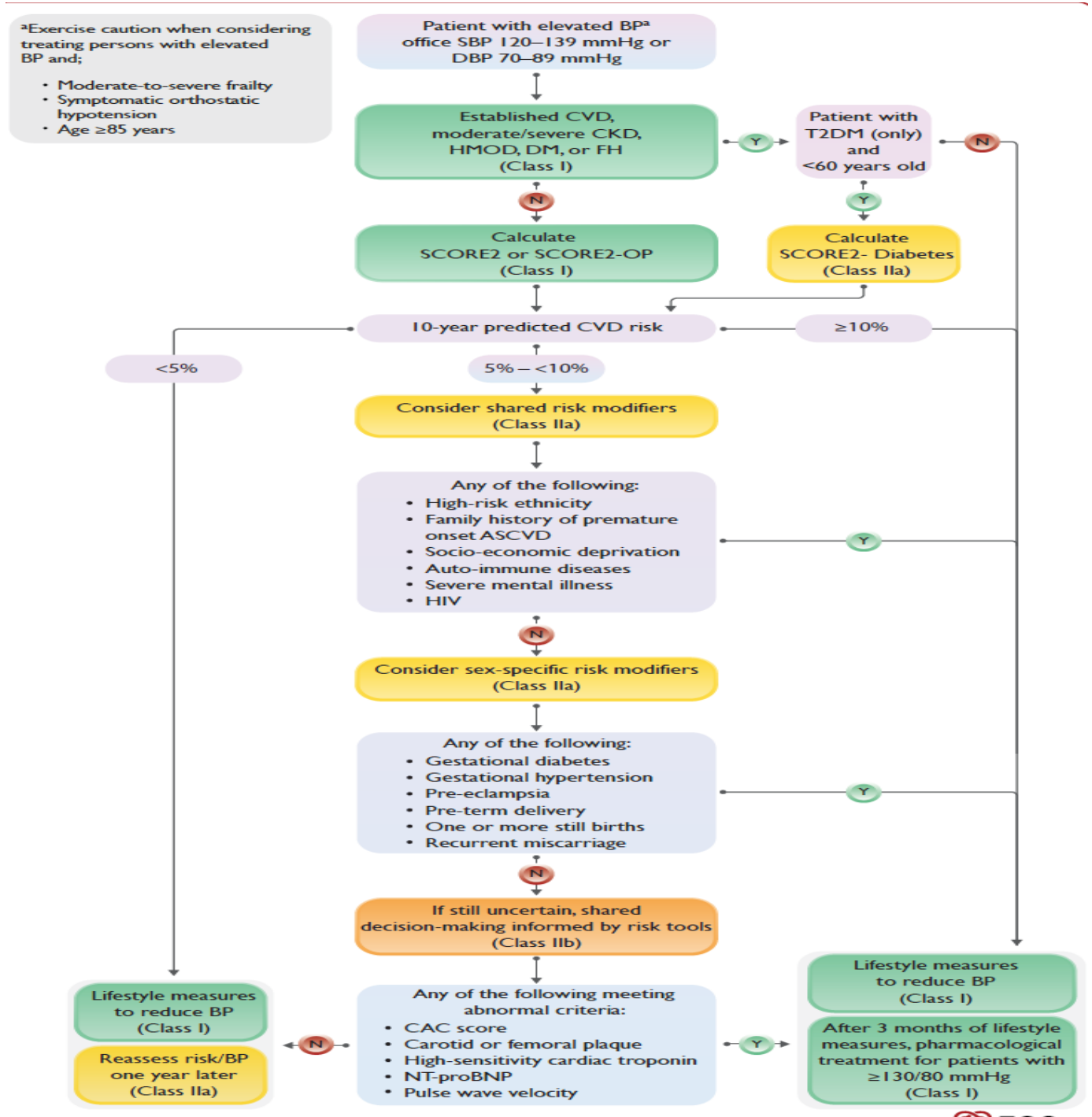

Family history of premature onset ASCVD

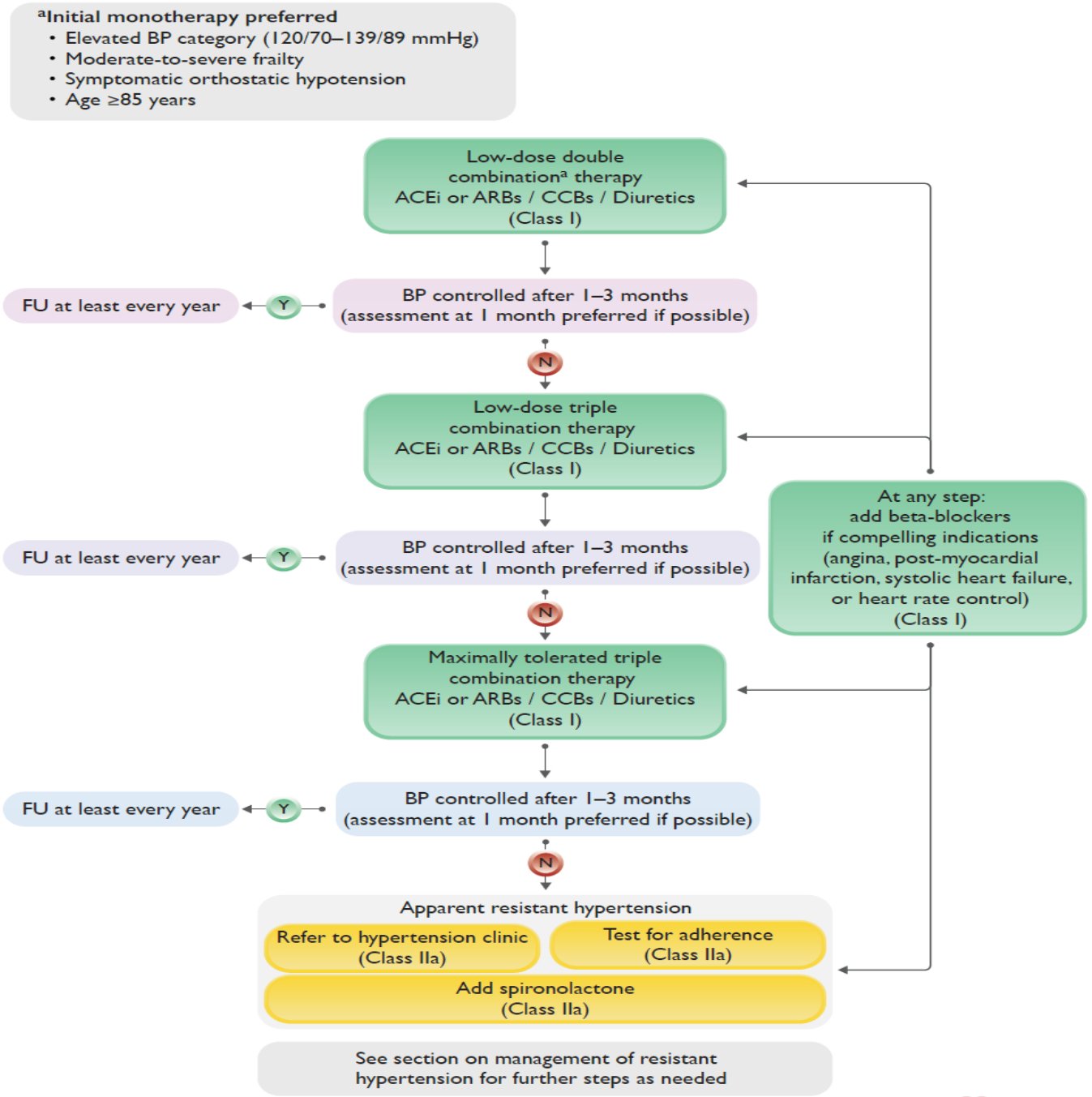

Socio-economic deprivation


Auto-immune inflammatory diseases


Severe mental illness


HIV


[a]Exercise caution when considering treating persons with elevated BP and;
• Moderate-to-severe frailty
• Symptomatic orthostatic hypotension
• Age ≥85 years
Patient with elevated BP[a] office SBP 120–139 mmHg or DBP 70–89 mmHg
Established CVD, moderate/severe CKD, HMOD, DM, or FH (Class I)
Y
Patient with T2DM (only) and <60 years old
N
Y
N
Calculate SCORE2 or SCORE2-OP (Class I)
Calculate SCORE2- Diabetes (Class IIa)
10-year predicted CVD risk
≥10%
<5%
5% – <10%
Consider shared risk modifiers (Class IIa)
Any of the following:
• High-risk ethnicity
• Family history of premature onset ASCVD
• Socio-economic deprivation
• Auto-immune diseases
• Severe mental illness
• HIV
Y
N
Consider sex-specific risk modifiers (Class IIa)
Any of the following:
• Gestational diabetes
• Gestational hypertension
• Pre-eclampsia
• Pre-term delivery
• One or more still births
• Recurrent miscarriage
Y
N
If still uncertain, shared decision-making informed by risk tools (Class IIb)
Lifestyle measures to reduce BP (Class I)
Reassess risk/BP one year later (Class IIa)
N
Any of the following meeting abnormal criteria:
• CAC score
• Carotid or femoral plaque
• High-sensitivity cardiac troponin
• NT-proBNP
• Pulse wave velocity
Y
Lifestyle measures to reduce BP (Class I)
After 3 months of lifestyle measures, pharmacological treatment for patients with ≥130/80 mmHg (Class I)


[a]Initial monotherapy preferred
• Elevated BP category (120/70–139/89 mmHg)
• Moderate-to-severe frailty
• Symptomatic orthostatic hypotension
• Age ≥85 years
Low-dose double combination[a] therapy ACEi or ARBs / CCBs / Diuretics (Class I)
BP controlled after 1–3 months (assessment at 1 month preferred if possible)
Y
FU at least every year
N
Low-dose triple combination therapy ACEi or ARBs / CCBs / Diuretics (Class I)
BP controlled after 1–3 months (assessment at 1 month preferred if possible)
Y
FU at least every year
N
Maximally tolerated triple combination therapy ACEi or ARBs / CCBs / Diuretics (Class I)
BP controlled after 1–3 months (assessment at 1 month preferred if possible)
Y
FU at least every year
N
At any step: add beta-blockers if compelling indications (angina, post-myocardial infarction, systolic heart failure, or heart rate control) (Class I)
Apparent resistant hypertension
Refer to hypertension clinic (Class IIa)
Test for adherence (Class IIa)
Add spironolactone (Class IIa)
See section on management of resistant hypertension for further steps as needed

# 6.2. Hypertensive Emergencies and Severe Hypertension in Nonpregnant and Nonstroke Patients

**Recommendations for Hypertensive Emergencies and Severe Hypertension in Nonpregnant and Nonstroke Patients* References that support recommendations are summarized in the Evidence Table.**

| COR | LOE | Recommendations |
|---|---|---|
| 1 | B-NR | 1. In adults with a hypertensive emergency (BP >180 and/or >120 mm Hg and evidence of acute target organ damage), admission to an intensive care unit is recommended for continuous monitoring of BP and target organ damage and for consideration of parenteral administration of appropriate therapy (Tables 26 and 27, Figure 9).[1–3] |

| Recommendations for Hypertensive Emergencies and Severe Hypertension in Nonpregnant and Nonstroke Patients* (Continued) | | |
|---|---|---|
| **COR** | **LOE** | **Recommendations** |
| **1** | **C-LD** | 2. For adults with a hypertensive emergency related to a compelling condition (eg, acute aortic syndrome or acute aortic dissection), SBP should be reduced to <140 mm Hg for most conditions and to <120 mm Hg in aortic dissection during the first hour, while monitoring for other target organ dysfunction.[4–7] |
| **1** | **C-LD** | 3. For adults with a hypertensive emergency but without a compelling condition, SBP should be reduced with oral or parenteral therapy by no more than 25% within the first hour; then, if stable, to <160/100 mm Hg within the next 2 to 6 hours; and then cautiously to 130 to 140 mm Hg during the next 24 to 48 hours to limit target organ injury.[2,8,9] |
| **3: Harm** | **B-NR** | 4. For adults with severe hypertension (>180/120 mm Hg) who are hospitalized for noncardiac conditions without evidence of acute target organ damage, intermittent use of additional IV or oral antihypertensive medications are not recommended to acutely reduce BP.[8,10,11] |

*Hypertensive emergencies in patients with acute ICH and acute ischemic stroke are discussed in Section 5.3.9 ("Cerebrovascular Disease") and in pregnant adults in Section 11.5 ("Hypertension and Pregnancy").

**Table 26. Intravenous Antihypertensive Drugs for Treatment of Hypertensive Emergencies**

| Class | Drug(s) | Usual Dose Range | Comments |
|---|---|---|---|
| CCB—dihydropyridines | Nicardipine | Initial 5 mg/h, increasing every 5 min by 2.5 mg/h to maximum 15 mg/h | Contraindicated in advanced aortic stenosis; no dose adjustment needed for persons aged ≥65 y. No negative inotropic or chronotropic effects. |
| | Clevidipine | Initial 1-2 mg/h, doubling every 90 s until BP approaches target, then increasing by less than double every 5-10 min; maximum dose 21 mg/h; maximum duration 72 h | Contraindicated in patients with soybean, soy product, egg, and egg product allergy and in patients with defective lipid metabolism (eg, pathological hyperlipidemia, lipoid nephrosis [minimal change disease] or acute pancreatitis). No negative inotropic or chronotropic effects. Decreased risk of reflex tachycardia. |
| Vasodilators—nitric-oxide dependent | Sodium nitroprusside | Initial 0.3-0.5 mcg/kg/min; increase in increments of 0.5 mcg/kg/min every 5 min to achieve BP target; maximum dose 10 mcg/kg/min; duration of treatment as short as possible | Due to potency, intra-arterial BP monitoring is recommended to prevent "overshoot." Lower dose required for older adults. Tachyphylaxis is common with extended use. No negative inotropic or chronotropic effects.<br>Due to increased mortality risk, should be avoided in acute cerebrovascular disease unless other agents are not available. Use cautiously in pregnancy or older adults.<br>Cyanide toxicity (increased risk in liver dysfunction and chronic kidney disease) and thiocyanate toxicity (increased risk in kidney dysfunction, sCr >3) may occur for infusion rates ≥3 mcg/kg/min and/or duration ≥3 d. Cyanide toxicity and thiocyanate toxicity may present similarly with metabolic acidosis, altered mental status, and cardiac arrhythmia. For either toxicity state, nitroprusside should be discontinued and sodium thiosulfate or cyanocobalamin should be administered. |
| | Nitroglycerin | Initial 5 mcg/min; increase in increments of 5 mcg/min every 3-5 min to a maximum rate of 200 mcg/min | Use only in patients with acute coronary syndrome and/or acute pulmonary edema. Do not use in volume-depleted patients. Tachyphylaxis is common with extended use. |
| Vasodilators—direct | Hydralazine | Initial 10 mg via slow IV infusion (maximum initial dose 20 mg); repeat every 4-6 h as needed. Adjust rate up to total cumulative dose of 200 mg/24 h | BP begins to decrease within 10-30 min, and the fall lasts 2-4 h. Hydralazine is an undesirable first-line agent for acute treatment in most patients due to unpredictability of response and prolonged duration of action. |
| Adrenergic blockers—beta-1 receptor selective antagonist | Esmolol | Loading dose 500-1000 mcg/kg/min over 1 min followed by a 50-mcg/kg/min infusion. For additional dosing, the bolus dose is repeated, and the infusion increased in 50-mcg/kg/min increments as needed to a maximum of 300 mcg/kg/min | Contraindicated in patients with concurrent beta-blocker therapy, bradycardia, or decompensated HF. Monitor for bradycardia.<br>Higher doses may block beta-2 receptors and impact lung function in reactive airway and obstructive pulmonary disease. |
| Adrenergic blockers—combined alpha-1 and nonselective beta receptor antagonist | Labetalol | Initial 0.3- to 1.0-mg/kg dose (maximum 20 mg) slow IV injection every 2 min or 0.4-1.0-mg/kg/h IV infusion up to 3 mg/kg/h. Adjust rate up to total cumulative dose of 300 mg/24 h | Contraindicated in reactive airway or obstructive pulmonary disease. Especially useful in hyperadrenergic syndromes. May worsen HF and should not be given in patients with second- or third-degree heart block or bradycardia. |
| Adrenergic blockers—nonselective alpha receptor antagonist | Phentolamine | IV bolus dose 5 mg. Additional bolus doses every 10 min as needed to lower BP to target. Adjust rate up to total cumulative dose of 50 mg/24 h | Used in hypertensive emergencies induced by catecholamine excess (pheochromocytoma, interactions between monoamine oxidase inhibitors and other drugs or food, cocaine toxicity, amphetamine overdose, or clonidine withdrawal). |
| Dopamine-1-receptor selective agonist | Fenoldopam | Initial 0.1-0.3 mcg/kg/min; may be increased in increments of 0.05-0.1 mcg/kg/min every 15 min until target BP is reached. Maximum infu- | Contraindicated in patients at risk of increased intraocular pressure (glaucoma) or intracranial pressure and those with sulfite allergy. |

| | | | |
|---|---|---|---|
| | | | creased risk in kidney dysfunction, sCr >3) may occur for infusion rates ≥3 mcg/kg/min and/or duration ≥3 d. Cyanide toxicity and thiocyanate toxicity may present similarly with metabolic acidosis, altered mental status, and cardiac arrhythmia. For either toxicity state, nitroprusside should be discontinued and sodium thiosulfate or cyanocobalamin should be administered. |
| | Nitroglycerin | Initial 5 mcg/min; increase in increments of 5 mcg/min every 3-5 min to a maximum rate of 200 mcg/min | Use only in patients with acute coronary syndrome and/or acute pulmonary edema. Do not use in volume-depleted patients. Tachyphylaxis is common with extended use. |
| Vasodilators–direct | Hydralazine | Initial 10 mg via slow IV infusion (maximum initial dose 20 mg); repeat every 4-6 h as needed. Adjust rate up to total cumulative dose of 200 mg/24 h | BP begins to decrease within 10-30 min, and the fall lasts 2-4 h. Hydralazine is an undesirable first-line agent for acute treatment in most patients due to unpredictability of response and prolonged duration of action. |
| Adrenergic blockers–beta-1 receptor selective antagonist | Esmolol | Loading dose 500-1000 mcg/kg/min over 1 min followed by a 50-mcg/kg/min infusion. For additional dosing, the bolus dose is repeated, and the infusion increased in 50-mcg/kg/min increments as needed to a maximum of 300 mcg/kg/min | Contraindicated in patients with concurrent beta-blocker therapy, bradycardia, or decompensated HF. Monitor for bradycardia.<br>Higher doses may block beta-2 receptors and impact lung function in reactive airway and obstructive pulmonary disease. |
| Adrenergic blockers–combined alpha-1 and nonselective beta receptor antagonist | Labetalol | Initial 0.3- to 1.0-mg/kg dose (maximum 20 mg) slow IV injection every 2 min or 0.4-1.0-mg/kg/h IV infusion up to 3 mg/kg/h. Adjust rate up to total cumulative dose of 300 mg/24 h | Contraindicated in reactive airway or obstructive pulmonary disease. Especially useful in hyperadrenergic syndromes. May worsen HF and should not be given in patients with second- or third-degree heart block or bradycardia. |
| Adrenergic blockers–nonselective alpha receptor antagonist | Phentolamine | IV bolus dose 5 mg. Additional bolus doses every 10 min as needed to lower BP to target. Adjust rate up to total cumulative dose of 50 mg/24 h | Used in hypertensive emergencies induced by catecholamine excess (pheochromocytoma, interactions between monoamine oxidase inhibitors and other drugs or food, cocaine toxicity, amphetamine overdose, or clonidine withdrawal). |
| Dopamine-1-receptor selective agonist | Fenoldopam | Initial 0.1-0.3 mcg/kg/min; may be increased in increments of 0.05-0.1 mcg/kg/min every 15 min until target BP is reached. Maximum infusion rate 1.6 mcg/kg/min | Contraindicated in patients at risk of increased intraocular pressure (glaucoma) or intracranial pressure and those with sulfite allergy. |
| ACE inhibitor | Enalaprilat | Initial 1.25 mg over a 5-min period. Doses can be increased up to 5 mg every 6 h as needed to achieve BP target. Adjust rate up to total cumulative dose of 50 mg/24 h | Contraindicated in pregnancy and should not be used in acute MI or bilateral renal artery stenosis.<br>Mainly useful in hypertensive emergencies associated with high plasma renin activity.<br>Poorly defined dose adjustments for kidney failure and may worsen kidney injury in those with CKD. Relatively slow onset of action (15 min) and unpredictability of BP response. |

Modified with permission from Whelton et al.[1] Copyright 2018 American College of Cardiology Foundation and American Heart Association, Inc.
BP indicates blood pressure; CCB, calcium channel blocker; CKD, chronic kidney disease; HF, heart failure; IV, intravenous; and MI, myocardial infarction.

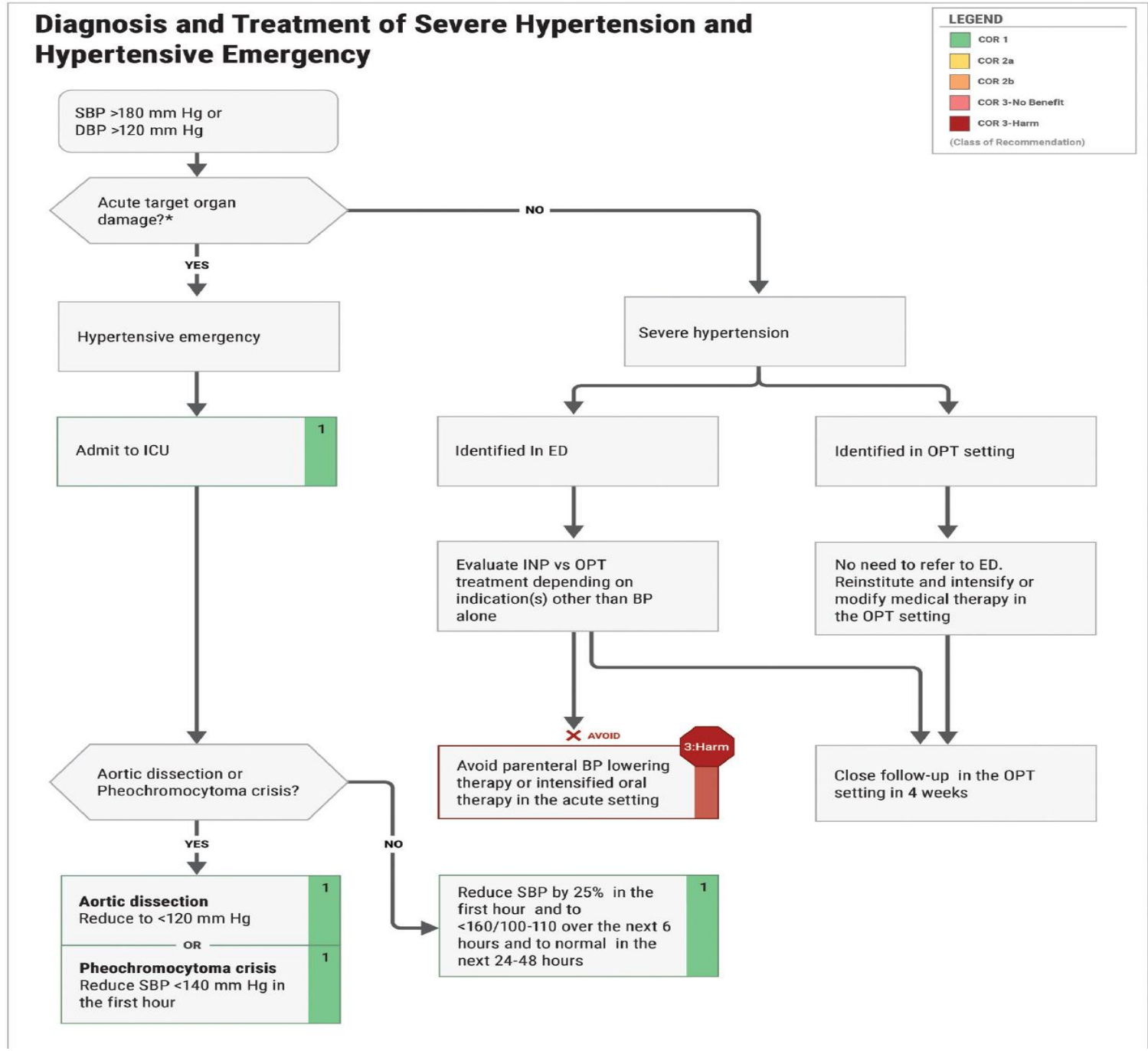
**Table 27. Intravenous Antihypertensive Drugs for Treatment of Hypertensive Emergencies in Patients With Selected Comorbidities**

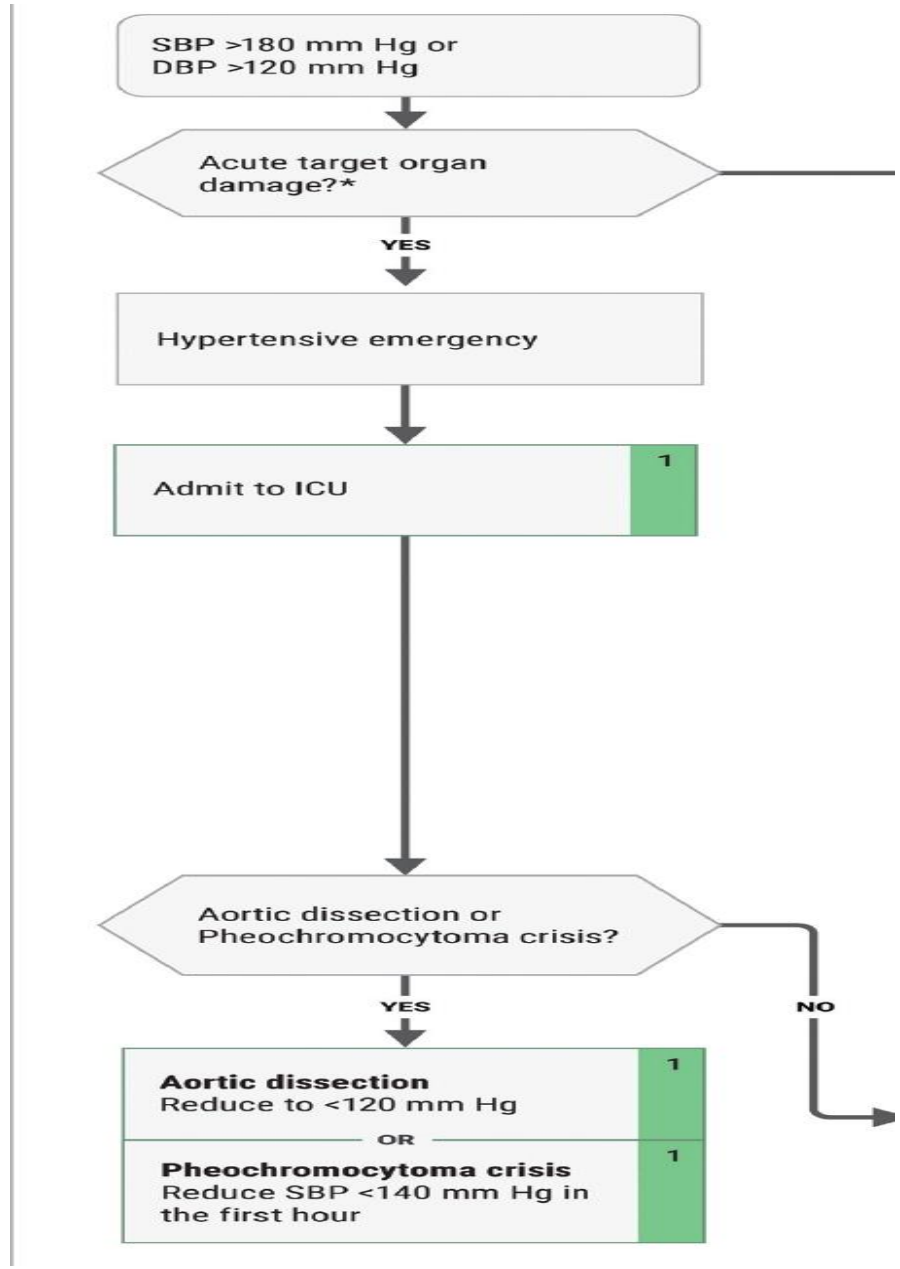
| Comorbidity | Preferred Drug(s)* | Comments |
|---|---|---|
| Acute aortic dissection | Esmolol, labetalol | Requires rapid lowering of SBP to ≤120 mm Hg. Beta blockade should precede vasodilator (eg, nicardipine or nitroprusside) administration, if needed for BP control or to prevent reflex tachycardia or inotropic effect; SBP ≤120 mm Hg should be achieved within 20 min. |
| Acute pulmonary edema | Clevidipine, nitroglycerin, nitroprusside | Beta blockers contraindicated. |
| Acute coronary syndromes | Esmolol†, labetalol, nicardipine, nitroglycerin† | Nitrates given in the presence of PDE-5 inhibitors may induce profound hypotension. Contraindications to beta blockers include moderate-to-severe LV failure with pulmonary edema, bradycardia (<60 beats/min), hypotension (SBP <100 mm Hg), poor peripheral perfusion, second- or third-degree heart block, and reactive airways disease. |
| Acute kidney injury | Clevidipine, fenoldopam, nicardipine | N/A |

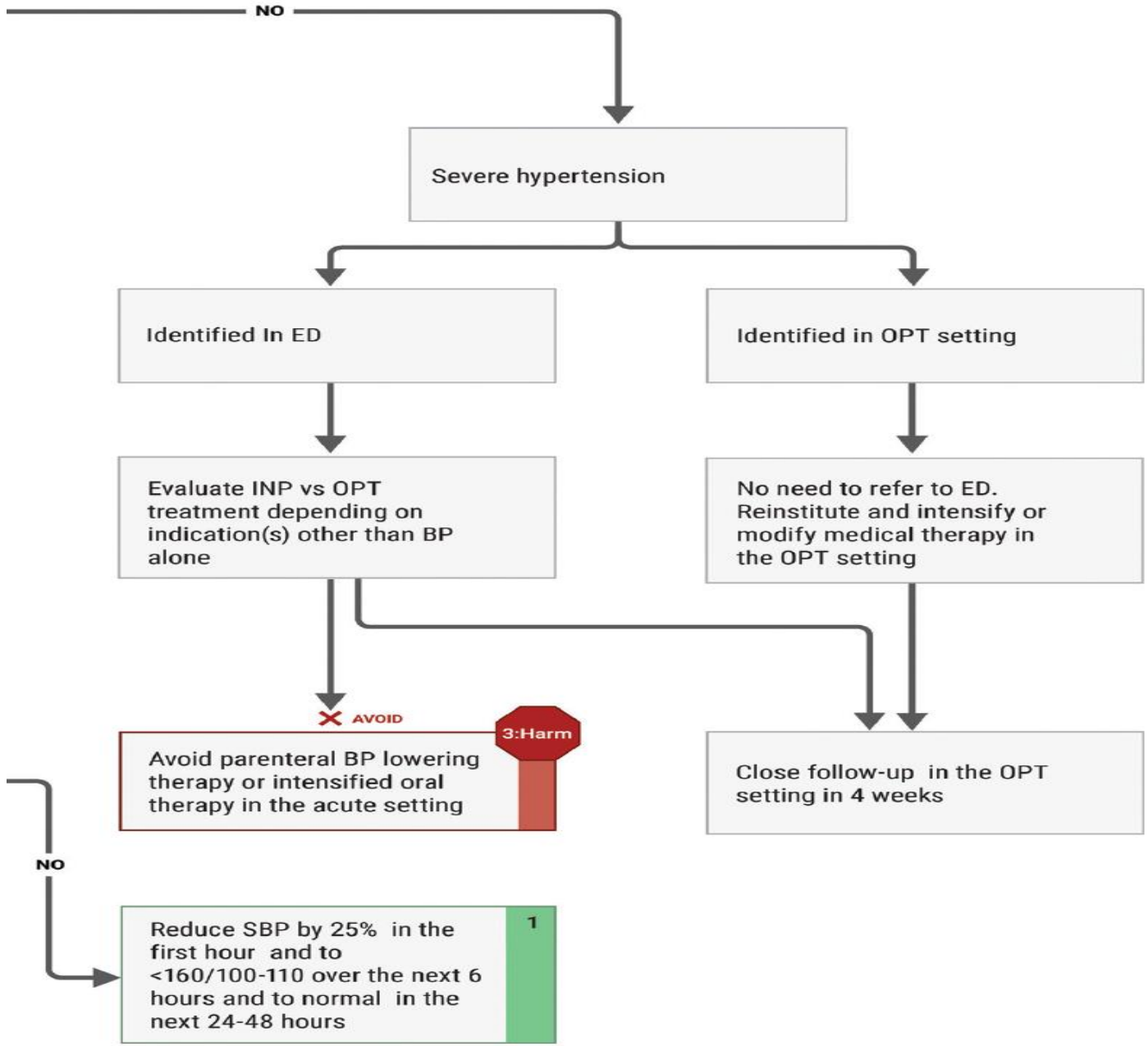
**Table 27. Intravenous Antihypertensive Drugs for Treatment of Hypertensive Emergencies in Patients With Selected Comorbidities**

| Comorbidity | Preferred Drug(s)* | Comments |
|---|---|---|
| Acute aortic dissection | Esmolol, labetalol | Requires rapid lowering of SBP to ≤120 mm Hg. Beta blockade should precede vasodilator (eg, nicardipine or nitroprusside) administration, if needed for BP control or to prevent reflex tachycardia or inotropic effect; SBP ≤120 mm Hg should be achieved within 20 min. |
| Acute pulmonary edema | Clevidipine, nitroglycerin, nitroprusside | Beta blockers contraindicated. |
| Acute coronary syndromes | Esmolol†, labetalol, nicardipine, nitroglycerin† | Nitrates given in the presence of PDE-5 inhibitors may induce profound hypotension. Contraindications to beta blockers include moderate-to-severe LV failure with pulmonary edema, bradycardia (<60 beats/min), hypotension (SBP <100 mm Hg), poor peripheral perfusion, second- or third-degree heart block, and reactive airways disease. |
| Acute kidney injury | Clevidipine, fenoldopam, nicardipine | N/A |
| Eclampsia or preeclampsia | Hydralazine, labetalol, nicardipine, nifedipine | Requires rapid BP lowering. ACE inhibitors, ARB, renin inhibitors, and nitroprusside contraindicated. |
| Perioperative hypertension (BP ≥160/90 mm Hg or SBP elevation ≥20% of the preoperative value that persists for >15 min) | Clevidipine, esmolol, nicardipine, nitroglycerin | Intraoperative hypertension is most frequently seen during anesthesia induction and airway manipulation. |
| Acute sympathetic discharge or catecholamine excess states (eg, pheochromocytoma, postcarotid endarterectomy status) | Clevidipine, nicardipine, phentolamine | Requires rapid lowering of BP. |
| Acute ICH | Clevidipine, nicardipine, esmolol, labetalol, hydralazine | Section 5.3.9.1 |
| Acute ischemic stroke | Clevidipine, nicardipine, esmolol, labetalol, hydralazine | Section 5.3.9.2 |

# Diagnosis and Treatment of Severe Hypertension and Hypertensive Emergency




SBP >180 mm Hg or
DBP >120 mm Hg
Acute target organ damage?*
YES
Hypertensive emergency
Admit to ICU
1
Aortic dissection or Pheochromocytoma crisis?
YES
NO
Aortic dissection
Reduce to <120 mm Hg
1
OR
Pheochromocytoma crisis
Reduce SBP <140 mm Hg in the first hour
1


NO
Severe hypertension
Identified In ED
Identified in OPT setting
Evaluate INP vs OPT treatment depending on indication(s) other than BP alone
No need to refer to ED. Reinstitute and intensify or modify medical therapy in the OPT setting
AVOID
3:Harm
Avoid parenteral BP lowering therapy or intensified oral therapy in the acute setting
Close follow-up in the OPT setting in 4 weeks
NO
Reduce SBP by 25% in the first hour and to <160/100-110 over the next 6 hours and to normal in the next 24-48 hours
1