Prevention and Management of Hypertension

Based on 2025 AHA/ACC Guideline

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Prevalence

- ~47% of US adults have hypertension
  - Prevalence increases with age
  - With aging, population SBP levels tend to rise steadily to the end of life, whereas DBP levels rise until the fifth decade of life, plateau for a decade, and decrease

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%

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
Adults with SBP and DBP in 2 categories should be designated to the higher BP category

Importance of Hypertension

- Leading modifiable risk factor
  - CAD, stroke, PAD, HF, CKD, dementia
  - Major cause of global mortality
  - Strong graded relationship between BP and CVD risk
  - BP 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
  - Among individuals without major risk factors, relative CVD event rates increase, starting at SBP levels as low as 90 mm Hg
  - Absolute CVD rates are substantially higher at older compared with younger ages
  - Among middle-aged and older adults, the prevalence and risks associated with higher SBP are greater than those associated with higher DBP

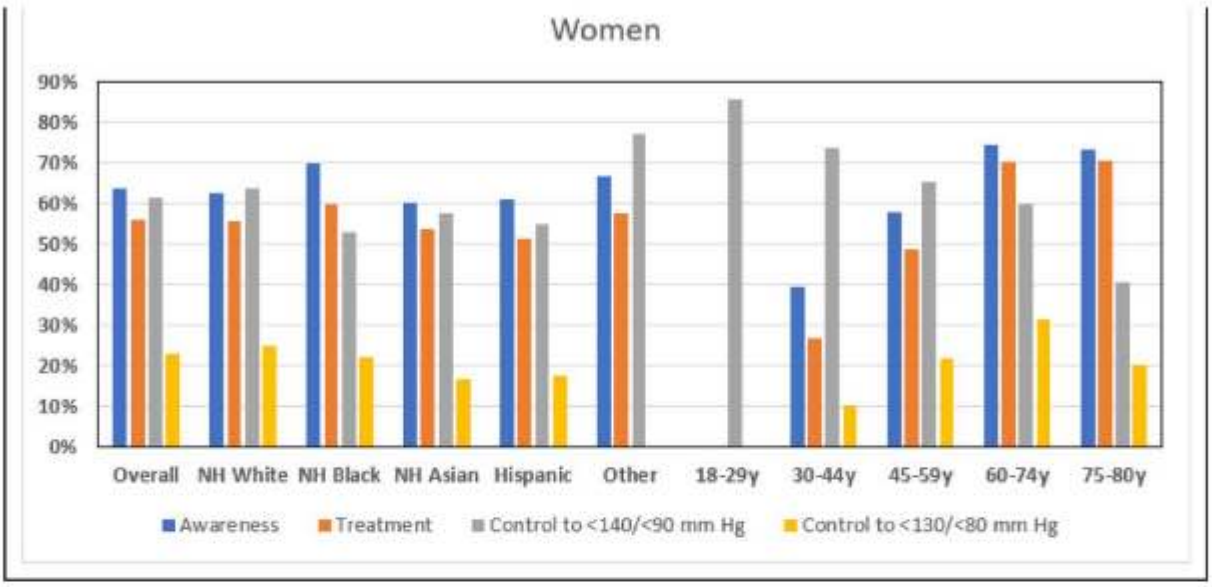


Figure 1. Rates of Awareness, Treatment, and Control of Hypertension Among US Adults Aged 18 to 80 Years, 2017 to 2020*.
*Missing data points indicate uncertain estimates due to small sample sizes for that subgroup. NH indicates non-Hispanic. Derived from NHANES.[3]

3.1.2. Patient Evaluation, Including Laboratory Tests and Other Diagnostic Procedures

Recommendation for Laboratory Tests and Other Diagnostic Procedures		
COR	**LOE**	**Recommendation**
1	C-EO	1. For adults who are diagnosed with hypertension, laboratory tests (ie, complete blood count, serum electrolytes, serum creatinine, lipid profile, glucose or hemoglobin A1c [HbA1c], thyroid-stimulating hormone, urinalysis, and urine albumin-to-creatinine ratio) and diagnostic procedures (12-lead ECG) should be performed to optimize management.

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

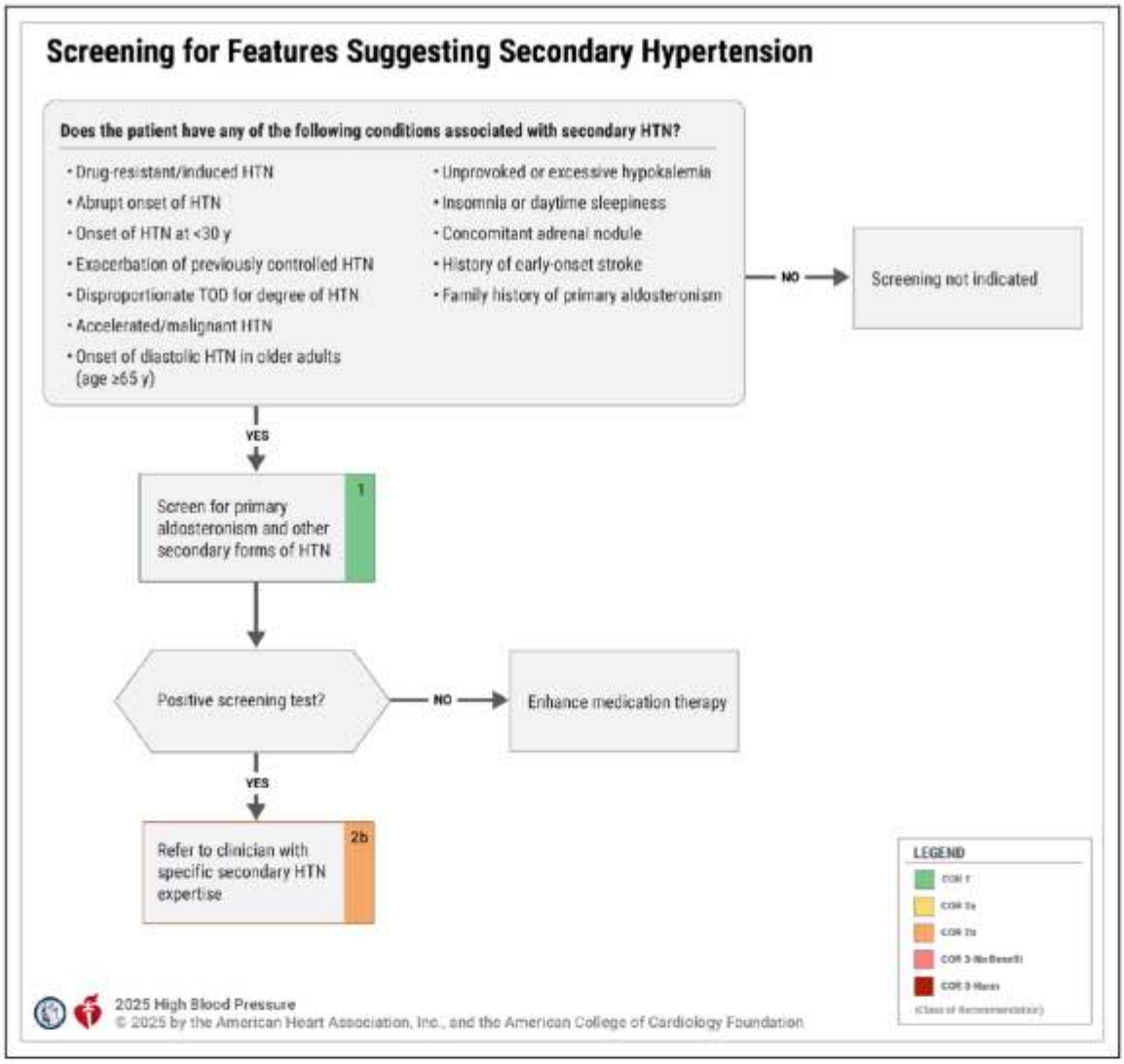
Table 8. Environmental, Behavioral, and Genetic Causes of Hypertension

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

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 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 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 Limit acetaminophen to less than 4 g/d[12] 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 Consider behavioral therapies or nonstimulants (such as guanfacine) for ADHD[32]
Antidepressants† (eg, MAOIs, SNRIs, TCAs)	Consider alternative agents (eg, SSRIs) depending on indication Avoid tyramine-containing foods with MAOIs
Atypical antipsychotics† (eg, risperidone, olanzapine)[33,34]	Discontinue or limit use when possible Consider behavior therapy where appropriate Recommend lifestyle modification (Section 5.1 "Lifestyle and Psychosocial Approaches") 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
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) Avoid use in women with uncontrolled hypertension[35]
Systemic corticosteroids† (eg, dexamethasone, fludrocortisone, methylprednisolone, prednisone, prednisolone)	Avoid or limit use when possible 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 Consider alternative chemotherapy


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
YES
Screen for primary aldosteronism and other secondary forms of HTN
1
Positive screening test?
NO
Enhance medication therapy
YES
Refer to clinician with specific secondary HTN expertise
2b
LEGEND
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Rationale for Early Prevention

- Vascular damage begins at SBP ≥120
  - Residual risk persists after BP control
  - Individuals with a diagnosis of hypertension who have treated SBP/DBP levels < 120/80 mm Hg have twice the risk for CVD of adults without hypertension who have untreated SBP/DBP levels < 120/80 mm Hg
  - Primordial prevention is critical

- Common forms of target organ damage: left ventricular hypertrophy, HF, subclinical and clinical atherosclerosis, CKD (ie, reduced eGFR or albuminuria), and cerebrovascular disease (eg, stroke, dementia, retinopathy).
- An association between hypertension and target organ damage, at least 1 form of hypertension-related target organ damage is present in >50% of individuals with hypertension.
- Relationships between the severity of hypertension and the number of organs affected by hypertension, as well as the number of affected organs and increased CVD risk

Dietary sodium reduction may be contraindicated in patients with severe, symptomatic orthostatic hypotension

5.1. Lifestyle and Psychosocial Approaches

Recommendations for Lifestyle and Psychosocial Approaches
Referenced studies that support the recommendations are summarized in the Evidence Table.

COR	LOE	Recommendations
Weight		
1	A	1. In adults who have overweight or obesity, weight loss is recommended with a goal of at least 5% of body weight reduction to prevent or treat elevated BP and hypertension.[1–9]
Diet and Nutrients		
1	A	2. In adults with or without hypertension, a heart-healthy eating pattern, such as the DASH eating plan, is recommended to prevent or treat elevated BP and hypertension.[9–15]
1	A	3. In adults with or without hypertension, reduction of dietary sodium intake* is recommended to <2300 mg/d, moving toward an ideal limit of <1500 mg/d to prevent or treat elevated BP and hypertension.[4,12,16–19]
2a	A	4. In adults with or without hypertension, potassium-based salt substitutes† can be useful to prevent or treat elevated BP and hypertension, particularly for patients in whom salt intake 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.[170–24]
1	A	5. In adults with elevated BP or hypertension, moderate potassium supplementation,‡ ideally from dietary sources, is recommended to prevent or treat elevated BP and hypertension, except in the presence of CKD or use of drugs that reduce potassium excretion where monitoring of serum potassium levels is indicated.‡ [25–27]

aerobic and resistance exercise (≥150 minutes of moderate physical activity per week and resistance exercise ≥2 days per week)

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.[1,28–31]
Physical Activity		
1	A	7. In adults with or without hypertension, increasing physical activity, through a structured exercise program that includes aerobic exercise 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 reduction through transcendental meditation may be reasonable to prevent or treat elevated BP and hypertension, as an adjunct to lifestyle or medication interventions.[28,14,40]
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]

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

Intervention	Target/Biomarker	Evidence-Based Goals	Approximate Mean Change in SBP (mm Hg)*	
			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
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
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
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
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

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
Exercise	Aerobic exercise	90-150 min/wk 65%-75% heart rate reserve	−4 to −8	−2 to −7
	Dynamic resistance	90-150 min/wk 50%-80% 1 rep maximum 6 exercises, 3 sets/exercise, 10 repetitions/set	−2 to −7	−2 to −5
	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
Meditation	Transcendental meditation	Training by a professional, followed by 2 × 20 min sessions/d while seated comfortably with eyes closed	−5 to −7	−5
Breathing control	Slowing respiration	Device-guided session to decrease respiration to <10 breaths/min for 15 min/d	−5	−5

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

Recommendations for BP Treatment Threshold and the Use of CVD Risk Estimation to Guide Drug Treatment of Hypertension
Referenced studies that support the recommendations are summarized in the Evidence Table.

COR	LOE	Recommendations
1	A	1. In all adults with hypertension, initiation of medications to lower BP is recommended when average SBP is ≥140 mm Hg to reduce the risk of cardiovascular events and total mortality.[1–6]
1	A	2. In all adults with hypertension, initiation of medications to lower BP is recommended when average DBP is ≥90 mm Hg to reduce the risk of cardiovascular events and total mortality.[1–6]
1	A	3. In adults with hypertension and clinical CVD, initiation of medications to lower BP is recommended when average SBP is ≥130 mm Hg to reduce the risk of cardiovascular events and total mortality.[5–11]
1	C-LD	4. In adults with hypertension and clinical CVD, initiation of medications to lower BP is recommended when average DBP is ≥80 mm Hg to reduce the risk of cardiovascular events and total mortality.[5–6]

- Based on BP level alone, all adults with hypertension benefit from antihypertensive therapy at a threshold of ≥140/90 mm Hg.
- Adults with hypertension and clinical CVD (coronary heart disease, stroke, or HF) are at increased risk for CVD events and benefit from antihypertensive therapy at a lower BP threshold of ≥130/80 mm Hg to prevent recurrent events

Recommendations for BP Treatment Threshold and the Use of CVD Risk Estimation to Guide Drug Treatment of Hypertension (Continued)		
COR	LOE	Recommendations
1	A	5. In adults with hypertension without clinical CVD but with diabetes or CKD or at increased short-term CVD risk (ie, estimated 10-year CVD risk ≥7.5% based on PREVENT*), initiation of medications to lower BP is recommended when average SBP is ≥130 mm Hg to reduce the risk of CVD events and total mortality.[5–10]
1	C-LD	6. In adults with hypertension without clinical CVD but with diabetes or CKD or at increased 10-year CVD risk (ie, ≥7.5% based on PREVENT*), initiation of medications to lower BP is recommended when average DBP is ≥80 mm Hg to reduce the risk of CVD events and total mortality.[5–10]
1	B-R	7. In adults with hypertension without clinical CVD and with estimated 10-year CVD risk <7.5% based on PREVENT,* initiation of medications to lower BP is recommended if average SBP remains ≥130 mm Hg after a 3- to 6-month trial of lifestyle intervention to prevent target organ damage and mitigate further rise in BP.[79,10]
1	B-R	8. In adults with hypertension without clinical CVD and with estimated 10-year CVD risk <7.5% based on PREVENT,* initiation of medications to lower BP is recommended if average DBP ≥80 mm Hg after a 3- to 6-month trial of lifestyle intervention to prevent target organ damage and mitigate further rise in BP.[79,10]

*Increased short-term or 10-year risk is defined as a 10-year predicted risk for CVD events of ≥7.5% based on PREVENT (Predicting Risk of cardiovascular disease EVENTs).

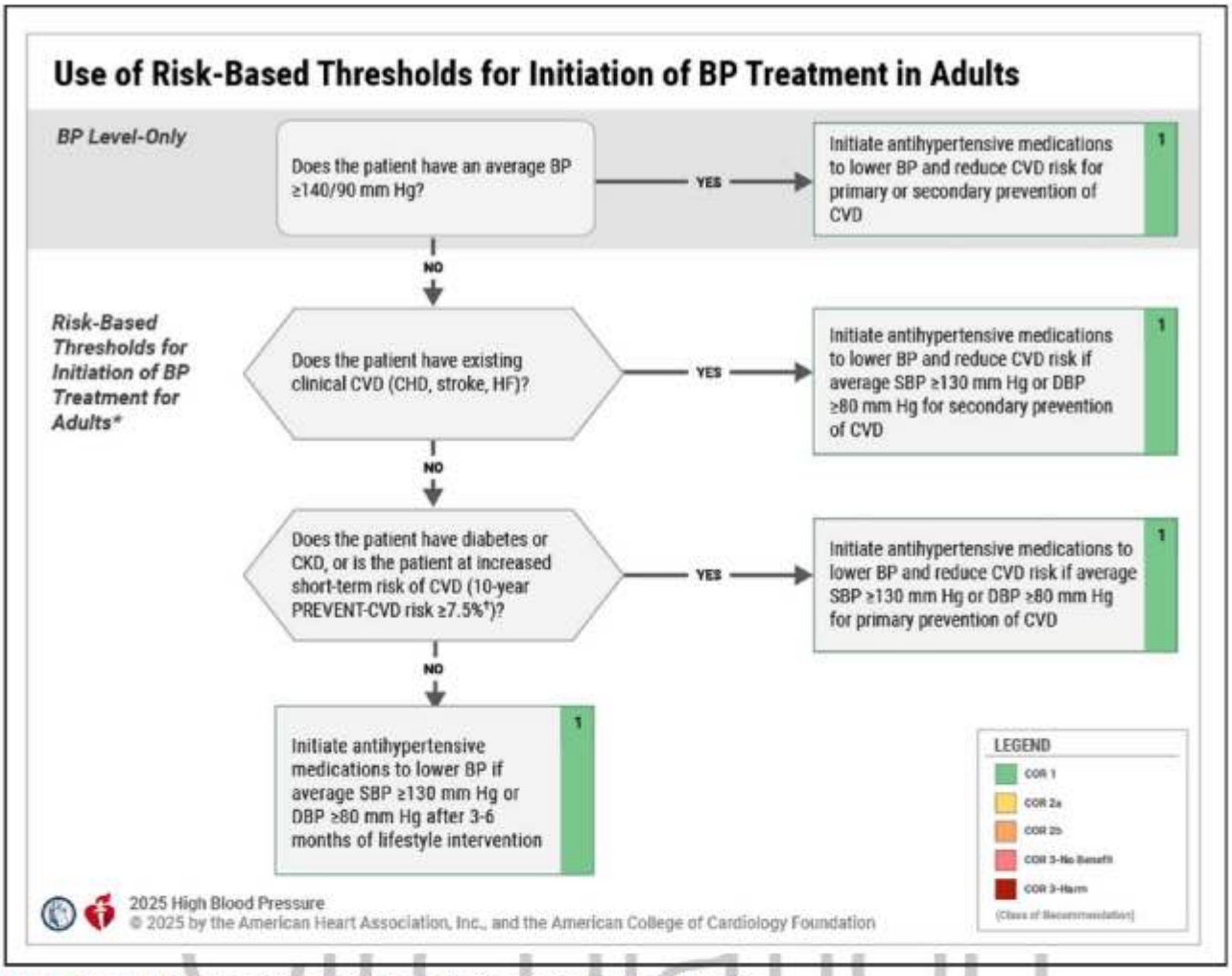


Figure 6. Use of Risk-Based Thresholds for Initiation of BP Treatment in Adults.

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]

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]

Table 13. FDA-Approved Drugs for Treatment of Hypertension

Class	Drug	Usual Dose, Range (mg/d)*	Daily Frequency	Comments
Agents recommended for initial therapy				
Thiazide-type diuretics	Chlorthalidone	12.5-25	1	Chlorthalidone has a longer half-life and is more potent than hydrochlorothiazide on a mg-to-mg basis. Monitor for hyponatremia and hypokalemia, increased glucose, uric acid, and calcium levels. Monitor patients with history of acute gout unless patient is on uric acid-lowering therapy.
	Hydrochlorothiazide	25-50	1	
	Indapamide	1.25-2.5	1	
ACEi	Benazepril	10-40	1 or 2	Do not use in combination with ARB or direct renin inhibitor. There is an increased risk of hyperkalemia, especially in patients with CKD or in those on K+ supplements or K+-sparing drugs. There is a risk of acute renal failure in patients with severe bilateral renal artery stenosis. Do not use if patient has history of angioedema with ACEi. Avoid use in pregnancy.
	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	2.5-20	1 or 2	
	Trandolapril	1-4	1	
ARBs	Azilsartan	40-80	1	Do not use in combination with ACEi or direct renin inhibitor. There is an increased risk of hyperkalemia in CKD or in those on K+ supplements or K+-sparing drugs. There is a risk of acute renal failure in patients with severe bilateral renal artery stenosis. Do not use if patient has history of angioedema with ARBs. Patients with a history of angioedema with an ACE inhibitor can receive an ARB beginning 6 weeks after ACE inhibitor is discontinued. Avoid use in pregnancy.
	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	
CCB—dihydropyridines	Amlodipine	2.5-10	1	Associated with dose-related lower extremity edema, which is more common in women than men.
	Felodipine	2.5-10	1	
	Isradipine	5-10	2	
	Nicardipine SR	60-120	2	
	Nifedipine LA	30-90	1	
	Nisoldipine	17-34	1	

Alternative agents				
CCB–nondihydropyridines	Diltiazem ER	120-360	1	Avoid routine use with beta blockers because of increased risk of bradycardia and heart block. Do not use in patients with HFrEF. There are drug interactions with diltiazem and verapamil (CYP3A4 major substrate and moderate inhibitor).
	Verapamil IR	120-360	3	
	Verapamil SR	120-360	1 or 2	
	Verapamil-delayed onset ER	100-300	1 (in the evening)	
Diuretics–loop	Bumetanide	0.5-2	2	These are preferred diuretics in patients with symptomatic HF. They are preferred over thiazide-type diuretics in patients with moderate-to-severe CKD (eg, GFR <30 mL/min). The longer-acting choice of torsemide is preferred for treatment of hypertension. A loop diuretic is an option for patients who develop thiazide-type diuretic associated hyponatremia.
	Furosemide	20-80	2	
	Torsemide	5-10	1	
Diuretics–potassium-sparing	Amiloride	5-10	1 or 2	As monotherapy, these agents are minimally effective antihypertensive agents. Combination therapy of a potassium-sparing diuretic with a thiazide-type diuretic can be considered in patients with hypokalemia on thiazide-type diuretic monotherapy. Avoid use in patients with significant CKD (eg, GFR <45 mL/min).
	Triamterene	50-100	1 or 2	
Diuretics–aldosterone antagonists	Eplerenone	50-100	1 or 2	These are preferred agents in primary aldosteronism and resistant hypertension. Spironolactone is associated with greater risk of gynecomastia and impotence compared with eplerenone. Demonstrated efficacy as fourth-agent add-on therapy for resistant hypertension. Avoid use with K+ supplements, other K+-sparing diuretics, or significant renal dysfunction (eg, GFR <45 mL/min). Eplerenone often requires twice-daily dosing for adequate BP lowering. Avoid use in pregnancy.
	Spironolactone	25-100	1	

Beta blockers–cardioselective	Atenolol	25-100	2	Beta blockers are not recommended as first-line agents unless the patient has CHD or HF. These are preferred in patients with bronchospastic airway disease requiring a beta blocker. Bisoprolol and metoprolol succinate are preferred in patients with HFrEF. 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. Avoid abrupt cessation.
Beta blockers–noncardioselective	Nadolol	40-120	1	Avoid use in patients with reactive airways disease. 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. 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. 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. Aliskiren is very long acting. There is an increased risk of hyperkalemia in CKD or in those on K+ supplements or K+-sparing drugs. Aliskiren may cause acute renal failure in patients with severe bilateral renal artery stenosis. 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. These may be considered a second-line agent in patients with symptomatic benign prostatic hypertrophy.
	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. Avoid abrupt discontinuation of clonidine, which may induce hypertensive crisis. 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. Hydralazine is associated with a drug-induced lupus-like syndrome at higher doses. 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. Indicated as add-on therapy for patients whose BP is not adequately controlled on other antihypertensive medications. Avoid use in pregnancy.

5.2.5. Antihypertensive Medication Adherence Strategies

Recommendations for Antihypertensive Medication Adherence Strategies Referenced studies that support the recommendations are summarized in the Evidence Table.		
COR	**LOE**	**Recommendations**
1	B-R	1. In adults with hypertension, antihypertensive medication dosing once daily rather than multiple times daily is beneficial to improve medication adherence.[1–3]
1	B-R	2. In adults with hypertension, the use of a SPC to reduce pill burden rather than taking separate pills is effective to improve medication adherence.[4–9]
2a	B-R	3. In adults with hypertension, use of medication reminder aids and educational or self-management interventions can be useful to improve medication adherence.[10–16]

- Up to 50% of patients do not adhere to their antihypertensive medications after 1 year of treatment
- Factors that contribute to poor adherence, including social determinants of health (SDOH), poor health literacy, stress, anxiety, and depression

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

Antihypertensive Medication Class Combination	Medication Combination
ACEi or ARB + Thiazide-type diuretic	Benazepril + HCTZ
ACEi or ARB + Calcium channel blocker	Benazepril + amlodipine
ARB + Beta blocker	Valsartan + nebivolol
Beta blocker + Thiazide-type diuretics	Atenolol + chlorthalidone
Potassium-sparing diuretic + thiazide-type diuretics	Amiloride + HCTZ
	Triamterene + HCTZ
MRA + thiazide-type diuretics	Spironolactone + HCTZ
ARB + CCB + thiazide-type diuretics	Olmesartan + amlodipine + HCTZ

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.

Monitoring adverse effects of intensive antihypertensive therapy

Achievement of target BP should be based on an average of ≥2 readings at ≥2 visits

- Assessment of electrolytes is important in evaluating causes of hypertension and in monitoring adverse effects with treatment.
- A basic metabolic panel should be checked 2 to 4 weeks after initiation or dose titration of specific antihypertensive medication classes, including diuretics, ACEi, ARB, and MRA.
- Treatment of hyperkalemia, other than emergency treatment for life-threatening hyperkalemia, can also be managed with initiation of potassium-lowering binders (including patiromer and sodium zirconium cyclosilicate), noting the importance of taking them (primarily patiromer) mid-day apart from other medications to avoid interfering with absorption

- Estimated GFR using serum creatinine should be measured 2 to 4 weeks after initiation or dose titration of antihypertensive medications.
- RAASi (including ACEi, ARB, and MRA) may lead to an expected reduction, or dip, in eGFR of up to 30% via vasodilation of efferent arterioles.
- This expected short-term dip in eGFR is associated with preservation of kidney function in the long-term and should not lead to discontinuation of the RAASi unless the decline in eGFR is persistently >30%.
- The presence of new kidney dysfunction/injury may also be observed with the addition or dose increase of diuretics (rule out hypovolemia and other possible causes of kidney dysfunction): initially hold or reduce the diuretic dose and then advance more slowly.

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 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

Table 17. Pharmacodynamic 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 of the 3 BBs proven to reduce mortality and hospitalizations (bisoprolol, carvedilol, metoprolol succinate).
MRA	In patients with symptomatic HFrEF, spironolactone or eplerenone is recommended to reduce morbidity and 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 functional class II to III symptoms, ARNi is recommended to reduce morbidity and mortality. 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 symptomatic HFrEF to reduce hospitalization and cardiovascular mortality irrespective of the presence of type 2 diabetes.
Additional GDMT to be added as indicated	
Hydralazine and isosorbide dinitrate	For patients self-identified as Black with NYHA functional class III to IV HFrEF who are receiving optimal medical therapy, the combination of hydralazine and isosorbide dinitrate is recommended to improve symptoms and reduce morbidity and mortality. In patients with current or previous symptomatic HFrEF who cannot be given first-line agents, such as ARNi, ACEi, or ARB, because of drug intolerance or renal insufficiency, a combination of hydralazine and isosorbide dinitrate might be considered to reduce morbidity and mortality.

HFpEF: similar, except for BB are not recommended
lower incident of AF with ACEi or ARB and MRA

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 identified by eGFR <60 mL/min/1.73 m^2 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 identified by eGFR <60 mL/min/1.73 m^2 with albuminuria of ≥30 mg/g, RAASi (either with ACEi or ARB but not both) is recommended to decrease CVD and delay progression of kidney disease.[4,5]

may be considered for those with lower level albuminuria (< 30 mg/g)

Cerebrovascular Disease
Stroke is a major cause of death, disability, and dementia

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 between 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 ICH to improve functional outcomes but stop antihypertensive medications if SBP <130 mm Hg.[1-3]
2a	B-NR	2. In adults with acute spontaneous ICH requiring acute BP lowering, careful titration to ensure smooth, nonlabile, and sustained control of BP, avoiding peaks and large variability in SBP, can be beneficial for improving functional outcomes.[3,4]
3: Harm	B-NR	3. For adult patients with acute spontaneous ICH who present with SBP >220 mm Hg, SBP should not be lowered below 130 mm Hg to reduce adverse events.[5-7]

Spontaneous, nontraumatic ICH is a significant global cause of morbidity and mortality.
Elevated BP is highly prevalent in the setting of acute ICH and is linked to greater hematoma expansion, neurological worsening, and death and dependency after ICH

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 patients with acute ischemic stroke, hypotension and hypovolemia should be corrected to maintain systemic perfusion levels necessary to support organ function.[1–3]
1	B-NR	2. Patients who have elevated BP and are otherwise eligible for treatment with IV thrombolytics should have their BP lowered to SBP <185 mm Hg and 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 after initiating thrombolytic therapy to avoid complications.[4,5]
2a	B-NR	3. In 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 to improve long-term functional outcomes and prevent death.[6,7]
2b	C-LD	4. In patients with 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 might be reasonable to lower BP by 15% during the first 24 hours after onset of stroke to improve outcomes.[2,3]
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	6. In patients 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.[12–14]

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 an ischemic stroke, TIA, or ICH, an office SBP/DBP goal of <130/80 mm Hg is recommended to reduce the risk of recurrent stroke, ICH, and other vascular events.[1,3–6]
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]

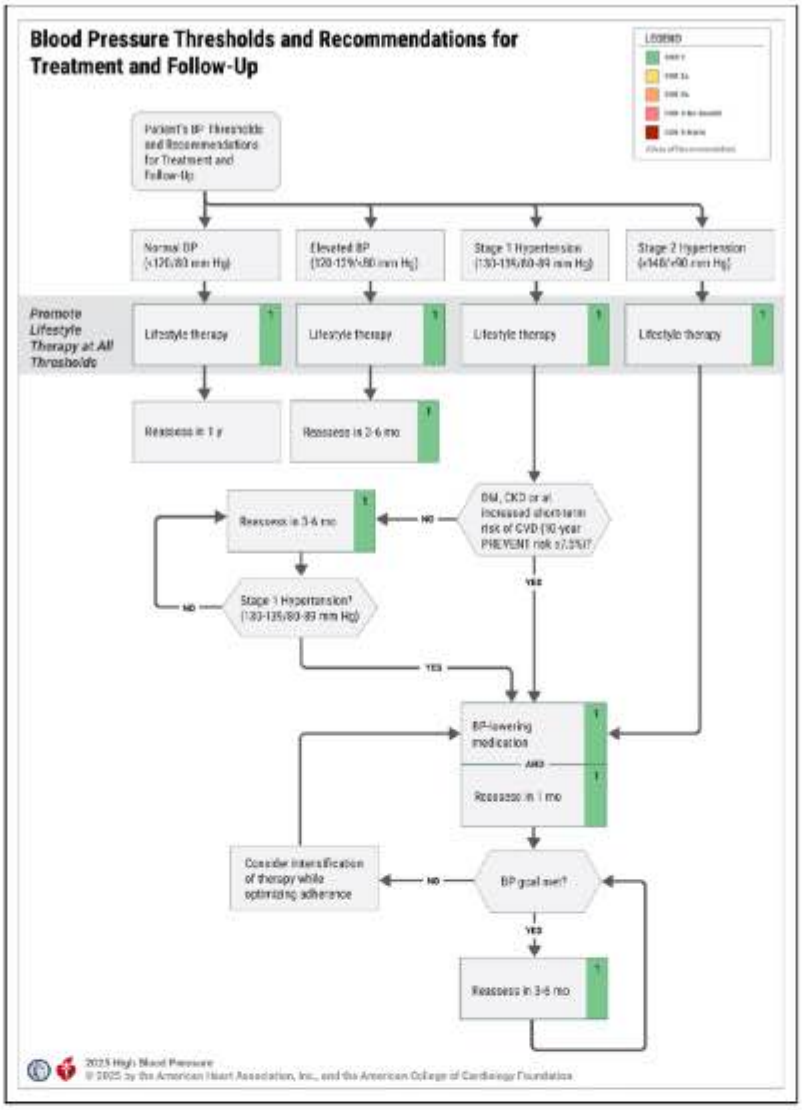
- Each year in the United States, >750000 adult patients experience a stroke, of which about 23% are recurrent strokes.
- More than 75% of ischemic stroke or ICH survivors have hypertension.
- Hypertension is the most important risk factor for stroke and ICH recurrence.
- Neurologically stable patients with cerebrovascular disease benefit from an SBP/DBP goal of < 130/80 mm Hg, and BP targets for stroke, ICH, and major vascular event prevention should be aligned with targets for prevention of other cardiovascular conditions

5.3.9.4. Mild Cognitive Impairment and Dementia

Recommendation for Prevention of Mild Cognitive Impairment and Dementia 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]

- Hypertension has been identified as a prevalent modifiable risk factor for cognitive decline and dementia.
- Cerebrovascular disease, a complication of hypertension, is commonly present in Alzheimer disease and related forms of dementia, where it frequently co-occurs with beta-amyloid and tau neuropathology. Hypertension is the primary risk factor for small-vessel ischemic disease and cortical white matter abnormalities in the brain, which are highly predictive of cognitive decline and dementia.
- Most observational studies and clinical trials have suggested that better control of SBP reduces Alzheimer's disease and related dementias, with the strongest association for BP lowering in middle age

- Hypertension is present in 35% to 55% of patients at the time of their PAD diagnosis and is the most common risk factor for PAD. Hypertension is associated with a longitudinal decline in ankle-brachial index in adults >65 years of age.2
- Treatment of hypertension to a goal BP of < 130/80 mm Hg in adults with PAD is optimal to reduce the risk of MACE, including stroke, MI, HF, and cardiovascular death
- Cardiovascular benefits are shown with the use of ACEi or ARB, and these agents should be first line for adults with PAD and hypertension.


Blood Pressure Thresholds and Recommendations for Treatment and Follow-Up
Legend
Patient's BP Thresholds and Recommendations for Treatment and Follow-Up
Normal BP (<120/80 mm Hg)
Elevated BP (120-129/<80 mm Hg)
Stage 1 Hypertension (130-139/80-89 mm Hg)
Stage 2 Hypertension (≥140/≥90 mm Hg)
Promote Lifestyle Therapy at All Thresholds
Lifestyle therapy
Lifestyle therapy
Lifestyle therapy
Lifestyle therapy
Reassess in 1 y
Reassess in 3-6 mo
Reassess in 3-6 mo
NO
DM, CKD or at increased short-term risk of CVD (10-year PREVENT risk ≥7.5%)?
YES
NO
Stage 1 Hypertension? (130-139/80-89 mm Hg)
YES
BP-lowering medication
AND
Reassess in 1 mo
Consider intensification of therapy while optimizing adherence
NO
BP goal met?
YES
Reassess in 3-6 mo
2025 High Blood Pressure
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- HDP are strongly associated with maternal and fetal/neonatal complications and are a leading cause of pregnancy-associated mortality.
- HDP are increasingly common in the United States, affecting 15.9% of deliveries
- The highest prevalence experienced by women aged ≥35 years, and women with obesity

5.5. Hypertension and Pregnancy

Recommendations for Individuals With Hypertension and Pregnancy* Referenced studies that support the recommendations are summarized in the Evidence Tables.

COR	LOE	Recommendations
1	A	1. For individuals with hypertension who are planning a pregnancy or who become pregnant, labetalol and extended-release nifedipine are preferred agents to treat hypertension and minimize fetal risk.[1]
1	B-R	2. Individuals with hypertension who are planning a pregnancy or who become pregnant should be counseled about the benefits of low-dose (81 mg/day) aspirin to reduce the risk of preeclampsia and its sequelae.[2]
1	B-R	3. Pregnant individuals with SBP ≥160 mm Hg or DBP ≥110 mm Hg confirmed on repeat measurement within 15 minutes should receive antihypertensive medication (Table 23) to lower BP to <160/<110 mm Hg within 30 to 60 minutes to prevent adverse events.[3–7]
1	B-R	4. Pregnant individuals with chronic† hypertension (defined as prepregnancy hypertension or SBP 140 to 159 mm Hg and/or DBP 90 to 109 mm Hg prior to 20 weeks' gestation) should receive antihypertensive therapy to achieve BP <140/90 mm Hg to prevent maternal and perinatal morbidity and mortality.[1,8,9]
3: Harm	C-LD	5. Individuals with hypertension who are planning a pregnancy or who become pregnant should not be treated with atenolol, ACEi, ARB, direct renin inhibitors, nitroprusside, or MRA to avoid fetal harm.[10–14]

Table 20. Classification of Hypertensive Disorders of Pregnancy[20]

Condition	Definition
Chronic hypertension	Diagnosis prior to pregnancy or at <20 wks' gestation
Gestational hypertension	De novo hypertension at ≥20 wks' gestation in the absence of proteinuria or other signs of preeclampsia
Preeclampsia	Gestational hypertension with proteinuria or other maternal end-organ dysfunction including neurologic findings, pulmonary edema, hematologic findings, acute kidney injury, hepatic dysfunction (Section 5.5.2 "Preeclampsia and Eclampsia, Including Preeclampsia Superimposed on Chronic Hypertension")
Preeclampsia superimposed on chronic hypertension	Preeclampsia in a woman with a history of hypertension before pregnancy or before 20 weeks' gestation

Table 21. ACOG Diagnostic Criteria for Hypertension in Pregnancy[20]

Condition	Definition
Hypertension in pregnancy	SBP ≥140 mm Hg and/or DBP ≥90 mm Hg
Severe-range hypertension	SBP ≥160 mm Hg and/or DBP ≥110 mm Hg

Table 22. Common Oral Antihypertensive Agents in Pregnancy

Drug	Dosage	Comments
Labetalol	200-2400 mg/d orally in 2 to 3 divided doses. Commonly initiated at 100-200 mg twice daily.	Potential bronchoconstrictive effects. Avoid in women with asthma, preexisting myocardial disease, decompensated cardiac function, and heart block and bradycardia.
Nifedipine	30-120 mg/d orally of an extended-release preparation. Commonly initiated at 30-60 mg once daily (extended release).	Do not use sublingual form. Immediate-release formulation should generally be reserved for control of severe, acutely elevated blood pressures in hospitalized patients. Should be avoided in tachycardia.
Methyldopa	500-3000 mg/d orally in 2 to 4 divided doses. Commonly initiated at 250 mg 2 or 3 times daily.	Safety data up to 7 y of age in offspring. May not be as effective as other medications, especially in control of severe hypertension. Use limited by side effect profile (sedation, depression, dizziness).
Hydrochlorothiazide	12.5-50 mg daily	Second- or third-line agent.

Table 24. Diagnostic Criteria for Preeclampsia

Blood pressure	SBP ≥140 mm Hg or DBP ≥90 mm Hg on 2 occasions at least 4 h apart after 20 wks of gestation in a woman with previously normal BP *or* SBP ≥160 mm Hg or DBP ≥110 mm Hg (severe hypertension can be confirmed within a short interval [min] to facilitate timely antihypertensive therapy).
AND	
Proteinuria	≥300 mg per 24-h urine collection (or this amount extrapolated from a timed collection) *or* Protein/creatinine ratio ≥0.3 *or* Dipstick reading of 2+ (used only if other quantitative methods are not available)
OR in the Absence of Proteinuria, New Onset Hypertension With the New Onset of Any of the Following:	
Thrombocytopenia: Platelet count <100 × 10^9/L	
Renal insufficiency: Serum creatinine concentrations >1.1 mg/dL or a doubling of serum creatinine concentration in the absence of other renal disease	
Impaired liver function: Elevated blood concentration of liver transaminases to twice normal concentration	
Pulmonary edema	
New-onset headache unresponsive to medication and not accounted for by the alternative diagnoses or visual symptoms	

Table 23. Antihypertensive Agents Used for Urgent Blood Pressure Control in Pregnancy

Drug	Dose	Comments	Onset of Action
Labetalol	10-20 mg IV, then 20-80 mg every 10-30 min to a maximum cumulative dosage of 300 mg; *or* constant infusion 1-3 mg/min IV	Tachycardia is less common with fewer adverse effects. Avoid in women with asthma, preexisting myocardial disease, decompensated cardiac function, and heart block and bradycardia.	1-2 min
Hydralazine	5 mg IV or IM, then 5-10 mg IV every 20-40 min to a maximum cumulative dosage of 20 mg; *or* constant infusion of 0.5-10 mg/h	Higher or frequent dosage associated with maternal hypotension, headaches, and abnormal fetal heart rate tracings; may be more common than other agents.	10-20 min
Nifedipine (immediate release)	10-20 mg orally, repeat in 20 min if needed; then 10-20 mg every 2-6 h; maximum daily dose is 180 mg	May observe reflex tachycardia and headaches.	5-10 min

5.6. Resistant Hypertension and Renal Denervation

Recommendations for Resistant Hypertension and Renal Denervation
Referenced studies that support the recommendations are summarized in the Evidence Table.

COR	LOE	Recommendations
Resistant Hypertension		
1	B-NR	1. In adults with resistant hypertension, a more detailed evaluation for secondary causes, to include careful review of all medications and removal of those with interfering effects on BP, is beneficial for lowering BP and simplifying treatment.[1-5]
1	B-R	2. In adults with uncontrolled resistant hypertension despite optimal treatment with first-line antihypertensive therapy (ie, a combination of ACEi or ARB plus CCB and thiazide-like diuretic [chlorthalidone or indapamide] and with an eGFR of ≥45 mL/min/1.73 m^2), addition of a MRA is recommended to control BP.[6,7]
2a	B-NR	3. In adults with uncontrolled resistant hypertension who cannot tolerate or have contraindications to MRA, the addition of one of the following agents or classes—amiloride, BBs, alpha-blockers, central sympatholytic drugs, dual endothelin receptor antagonists, or direct vasodilators—is reasonable to control BP.[8-11]
Renal Denervation		
2b	B-R	4. In carefully selected patients with systolic and diastolic hypertension (office SBP 140-180 mm Hg and DBP ≥90 mm Hg) and eGFR ≥40 mL/min/1.73 m^2 who have resistant hypertension despite optimal treatment, or intolerable side effects to additional antihypertensive drug therapy, renal denervation (RDN) may be reasonable as an adjunct treatment to BP medications and lifestyle modification to reduce BP.[12-14]

Recommendations for Resistant Hypertension and Renal Denervation (Continued)

COR	LOE	Recommendations
1	B-NR	5. All patients with hypertension who are being considered for RDN should be evaluated by a multidisciplinary team with expertise in resistant hypertension and RDN.[12-14]
1	C-EO	6. For patients with hypertension for whom RDN is contemplated, the benefits of lowering BP and potential procedural risks compared with continuing medical therapy should be discussed as part of a shared decision-making process to ensure patients choose the therapy that meets their expectations.

Table 25. Patient Selection for Renal Denervation

Resistant hypertension OR uncontrolled hypertension*
• Patients with stage 2 hypertension (with both office SBP ≥140 mm Hg and office DBP ≥90 mm Hg) in whom BP is not at goal despite taking ≥4 antihypertensive medications at optimal dosages (ACEi/ARB +CCB +thiazide-type diuretics, and MRA)[38,47] • Patients with stage 2 hypertension (with both office SBP ≥140 mm Hg and office DBP ≥90 mm Hg) who are unable to take antihypertensive medications at the optimal dosages or additional medications[11,12,14]
Contraindications[13,14,26–28,46]
• Neurogenic orthostatic hypotension • Pregnancy • Fibromuscular dysplasia • Stented renal artery • Renal artery aneurysm • Significant renal artery stenosis • Known kidney or secreting adrenal tumors

*After evaluation by a multidisciplinary team to screen for secondary hypertension and contraindications and following a shared decision-making process.[49]

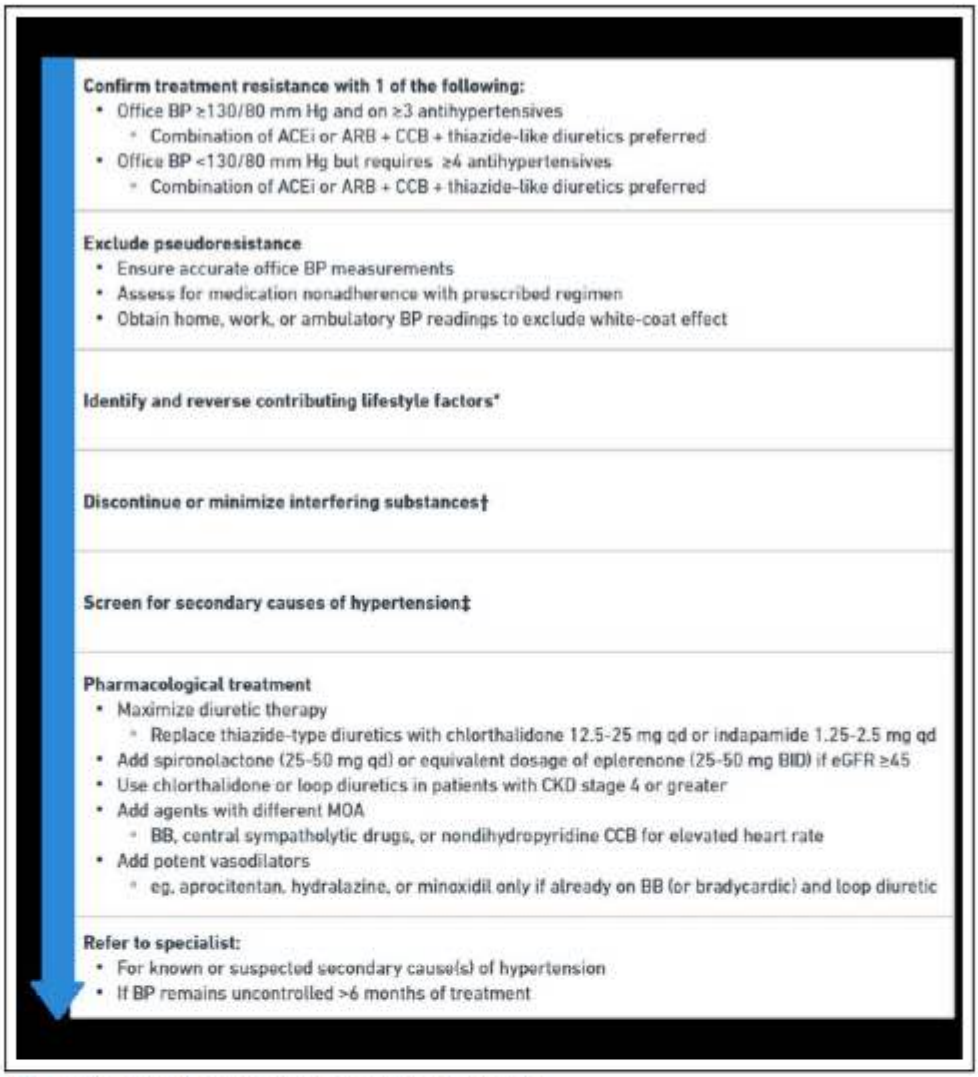


Figure 8. Resistant Hypertension: Diagnosis, Evaluation, and Treatment.

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 adults receiving intensive BP-lowering therapy with asymptomatic OH, treatment with a goal of SBP <130 mm Hg is reasonable due to increased CVD and mortality benefit.[3,5]
2a	B-R	3. In adults with hypertension initiating treatment or adding medication with a goal of SBP <130 mm Hg, assessment for symptomatic OH is reasonable to detect other chronic conditions.[1–4,6,7]

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]

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. 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. 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.

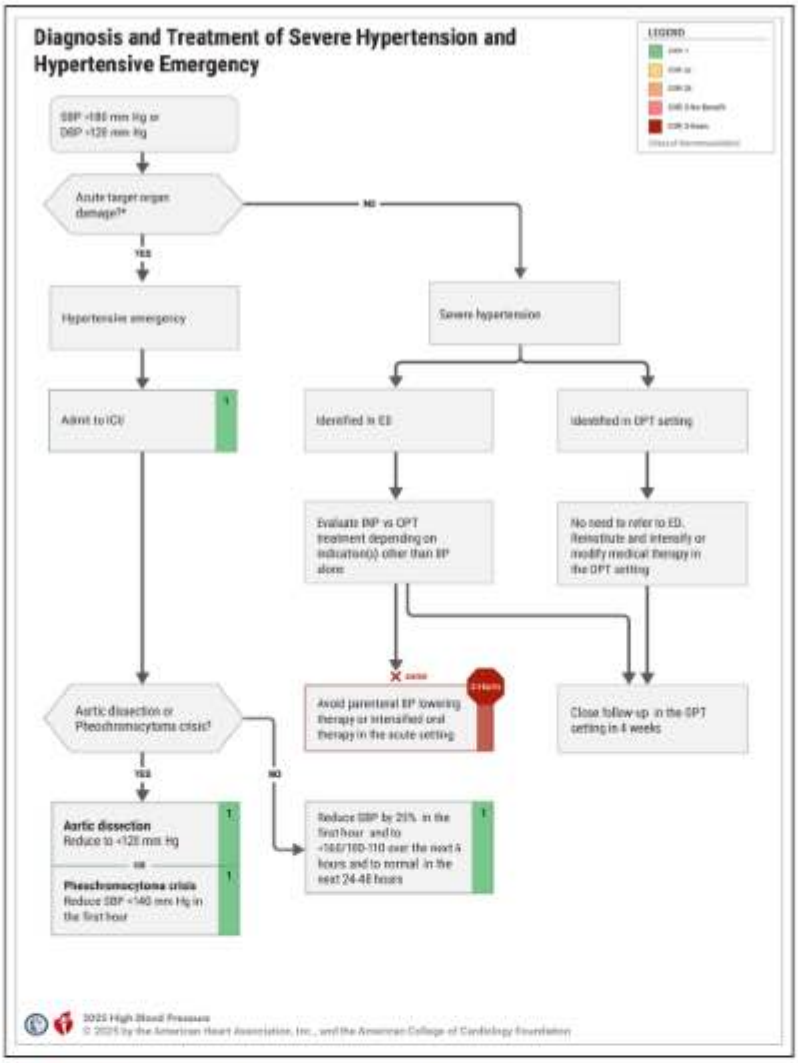
		[illegible]	[illegible]
Vasodilators–direct	Hydralazine	Initial 10 mg via slow IV infusion (maximum initial dose 20 mg); repeat every 4-6 h as needed. Adjust rate up to total cumulative dose of 200 mg/24 h	BP begins to decrease within 10-30 min, and the fall lasts 2-4 h. Hydralazine is an undesirable 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. 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. Mainly useful in hypertensive emergencies associated with high plasma renin activity. 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.

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

Recommendations for Patients Scheduled for Surgical Procedures Referenced studies that support the recommendations are summarized in the Evidence Tables.		
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 throughout the perioperative period to assist with BP control.[1–5]
2a	C-EO	2. In patients with hypertension scheduled for elective major surgery, it is reasonable to continue most medications for hypertension 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 to prevent hypotension 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 may be considered especially in high-risk patients to minimize perioperative complications.[11–13]
3: Harm	B-NR	5. In patients with hypertension scheduled for surgery, abrupt preoperative discontinuation of BB or clonidine may result in rebound hypertension and is potentially harmful.[14]
3: Harm	B-R	6. For patients with hypertension scheduled for surgery, BB should not be started on the day of surgery in BB-naïve patients because of increased risk of postoperative mortality.[4,15,16]



ıre 9. Diagnosis and Treatment of Severe Hypertension and Hypertensive Emergency.

Key Take-Home Messages

- Early prevention is essential
  - Lifestyle is universal therapy
  - Drugs reduce morbidity and mortality
  - Target <130/80 mm Hg