Hypertension Management: Evidence-Based Clinical Guide

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Hypertension Management: Evidence-Based Clinical Guide

Learning Objectives

After reviewing this handout, students should be able to: 1. Classify hypertension stages and understand measurement standards 2. Describe the role of out-of-office blood pressure monitoring in diagnosis 3. Identify first-line antihypertensive medications and their mechanisms 4. Apply evidence-based blood pressure targets based on patient risk 5. Recognize and manage special populations (diabetes, CKD, pregnancy, resistant HTN) 6. Interpret 2025 ACC/AHA guideline recommendations for treatment decisions

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Section 1: Blood Pressure Classification and Measurement

Hypertension Definitions (2025 Guidelines)

Category	Office BP	Home BP	ABPM 24-hr
Elevated	120-129/<80	<130/80	<130/80
Stage 1 HTN	130-139/80-89	≥130/80	≥130/80
Stage 2 HTN	≥140/90	≥140/90	≥140/90

Standardized Measurement Technique

Critical elements for accurate office BP measurement: - Patient seated 5 minutes with back supported, feet flat, arm at heart level - Proper cuff size (bladder encircles 80-100% of arm circumference) - Avoid caffeine, exercise, smoking for 30 minutes pre-measurement - Empty bladder before measurement - Take 2-3 readings 1-2 minutes apart; average the readings

Oscillometric vs. Auscultatory Methods: - Automated oscillometric devices preferred over manual auscultatory methods (Class 2a) - Oscillometric advantages: reproducibility, eliminates terminal digit bias, standardization - Disadvantage: algorithms are proprietary; only MAP directly measured, SBP/DBP are derived

Out-of-Office Monitoring (Essential for Diagnosis)

Home Blood Pressure Monitoring (HBPM): - Recommended: 7 consecutive days, 2 readings morning/evening, discard day 1 - Threshold for hypertension: ≥130/80 mmHg (home average) -

Preferred timing: morning pre-medication (captures trough effect) - Advantages: multiple readings, eliminates white coat effect, superior prognostic value

Ambulatory Blood Pressure Monitoring (ABPM) - Gold Standard: - 24-hour monitoring with readings every 15-30 min (day) and 30-60 min (night) - Diagnostic thresholds: ≥130/80 mmHg (24-hr), ≥135/85 mmHg (daytime), ≥120/70 mmHg (nighttime) - Captures nocturnal dipping patterns, morning surge, and true BP variability - Most predictive of cardiovascular outcomes

White Coat vs. Masked Hypertension

Phenotype	Office BP	ABPM/Home BP	Prevalence	Cardiovascular Risk
Normotension	<130/80	<130/80	60-70%	Baseline
White Coat HTN	130-159/80-99	<130/80	15-30%	1.2× baseline (low)
Masked HTN	<130/80	≥130/80	10-15%	1.6× baseline (significant)
Sustained HTN	≥130/80	≥130/80	~20%	2-3× baseline

Clinical Pearl: Always exclude white coat hypertension before treating Stage 1 HTN. Masked hypertension carries significant risk—screen patients with normal office BP but target organ damage.

Section 2: Blood Pressure Targets and Risk Stratification

PREVENT Cardiovascular Risk Calculator

The 2025 guidelines introduce PREVENT (Predicting Risk of CVD Events and Nonfatal Talk) equations—more accurate than older Pooled Cohort Equations by incorporating contemporary preventive therapies.

Treatment Thresholds: - **Stage 1 HTN (130-139/80-89) + PREVENT risk <7.5%**: Lifestyle modification for 3-6 months; consider meds if lifestyle fails - **Stage 1 HTN + PREVENT risk ≥7.5%**: Initiate pharmacotherapy - **Stage 2 HTN (≥140/90)**: Initiate pharmacotherapy regardless of risk (Class 1)

Blood Pressure Targets by Population

Population	Target SBP	Special Considerations
General/Diabetes/CKD	<130 mmHg	Intensive: consider <120 if tolerated
Coronary artery disease	<130 mmHg	Avoid J-curve (DBP <60 increases coronary risk)
Heart failure	<130 mmHg	RAAS inhibitors mandatory
Acute stroke	140 mmHg (ICH)	Avoid aggressive reduction post-ischemic stroke
Resistant HTN	<130 mmHg	Often requires 4+ agents

Population	Target SBP	Special Considerations
Elderly (>75 yrs)	<130 mmHg	Monitor for orthostasis; avoid <110 SBP

Evidence Summary (SPRINT Trial): - Intensive SBP <120 mmHg vs. standard <140 mmHg - 25% relative risk reduction in major CV events (absolute reduction ~2.5% over 5 years) - 27% reduction in mortality - Absolute NNT = 40-60 to prevent one event; requires careful patient selection

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Section 3: First-Line Antihypertensive Medications

The Four Foundation Drug Classes

1. ACE Inhibitors (ACEI) – Mechanism: Blocks angiotensin I□II conversion

Agent	Mechanism	Unique Features	Cautions
Lisinopril	Renal elimination (100%)	Long half-life (40-50 hrs in CKD)	Cough 10.6%, angioedema 0.3%
Ramipril	Hepatic + renal	HOPE trial cardioprotection	Cough, hyperkalemia risk
Fosinopril	Hepatic (80%)	Preferred in CKD (short washout to ARNI)	Well tolerated
Perindopril	Active metabolite	Ultra-long acting	Extended washout if ARNI transition

Side Effects (Absolute Risk): - Persistent cough: 10.6% (NNH 13 vs. ARBs) - Angioedema: 0.3% (serious, may recur years into therapy) - Hyperkalemia: 5.3% in general population; 9.7% in CKD stage 4-5

2. Angiotensin Receptor Blockers (ARB) – Mechanism: AT_1 receptor antagonism

Agent	Unique Properties	Indication
Losartan	Uricosuric (0.6-1.1 mg/dL UA reduction); CYP2C9 pro-drug	Hyperuricemia/gout + HTN
Telmisartan	Longest half-life (24 hrs); ONTARGET trial	Once-daily dosing convenience
Valsartan	Used in ARNIs; well-studied CKD	Albuminuria reduction

Advantages over ACEIs: - No cough (0.4% vs. 10.6%) - Lower angioedema risk (0.11% vs. 0.3%) - Similar BP reduction and CV outcomes - Better adherence (33% fewer discontinuations)

3. Calcium Channel Blockers (CCB) – Mechanism: L-type calcium antagonism □ arteriolar vasodilation

Subclass	Agent	Half-Life	Comments
Dihydropyridines	Amlodipine	30-50 hrs	No reflex tachycardia; edema common
	Extended-rel nifedipine	24 hrs	Avoid immediate-release (excessive variability)
Non-dihydropyridines	Diltiazem	3-4 hrs	Negative inotrope; bradycardia risk
	Verapamil	3-7 hrs	Constipation; contraindicated in HFrEF

Clinical Pearl: Dihydropyridine CCBs (e.g., amlodipine) maintain cardiac output and don't cause reflex tachycardia—preferred in most patients.

4. Thiazide and Thiazide-Like Diuretics – Mechanism: Renal tubular sodium/chloride reabsorption block

Agent	Potency Ratio	Half-Life	Use
Hydrochlorothiazide (HCTZ)	1.0	5-14 hrs	Avoid if possible (less potent, shorter acting)
Chlorthalidone	1.5-2.0× HCTZ	40-60 hrs	**Preferred** (superior BP reduction, sustained effect)
Indapamide	1.5-2.0× HCTZ	14-18 hrs	Good alternative to chlorthalidone

Key Metabolic Effects: - Hypokalemia: 5-10%, especially at doses >25 mg daily - Hyperglycemia: 2-3% new-onset diabetes - Hyperuricemia: may precipitate gout - Dyslipidemia: modest increases in total cholesterol

Renal Pearl: Despite metabolic effects, thiazides are still Class 1 for hypertension. Monitor electrolytes 4-12 weeks after initiation.

Section 4: Special Populations and Comorbidities

Diabetes Mellitus

BP Target: <130/80 mmHg (Class 1)

Preferred Medications: 1. RAAS inhibitors (ACEI/ARB) – **mandatory with any albuminuria** (including <30 mg/g) 2. Add CCB if not at goal with RAAS inhibitor monotherapy 3. Thiazide diuretic as second/third agent 4. Avoid dual RAAS blockade (ACEI + ARB or DRI) – increased HK, AKI, hypotension without CV benefit (Class 3 Harm)

Synergistic Agents: - GLP-1 agonists: 3-5 mmHg reduction + CV protection - SGLT2 inhibitors: 2-3 mmHg reduction + renal/HF protection

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Chronic Kidney Disease (CKD)

BP Target: <130/80 mmHg systolic across **all CKD stages** (Class 1)

Obligatory Therapy: - RAAS inhibition for albuminuric patients (≥30 mg/g creatinine) – renoprotective (Class 1) - Acceptable 30% creatinine rise in first 2-4 weeks (hemodynamic response, not progressive) - Add SGLT2 inhibitor for additive renal protection

Monitoring Parameters: - Check K+, Cr 1-2 weeks after RAAS inhibitor initiation - If K+ >5.5 mEq/L or Cr rise >30%: confirm true progression (repeat, rule out dehydration) - Urine-ACR at baseline and annually to assess albuminuria response

Clinical Pearl: ABPM (24-hour) more strongly predicts renal outcomes than office BP in CKD.

Resistant Hypertension

Definition: SBP ≥140 mmHg despite 3+ optimally-dosed medications (including diuretic), or requiring ≥4 agents to achieve goal.

Evaluation Algorithm: 1. **Confirm true resistance:** ABPM to rule out white coat effect (37.5% of apparent resistance) 2. **Assess adherence:** Pharmacy refill history, drug levels (lowest cost screening) 3. **Exclude secondary causes:** Primary aldosteronism (Class 1 universal screening regardless of K+ level—normokalemic phenotype common), RAS, OSA, hyperparathyroidism, hyperthyroidism 4. **Address modifiable factors:** Dietary sodium, NSAID/stimulant use, sleep apnea treatment

Fourth-Line Agent: - **Spironolactone (MRA):** 20-25 mmHg additional reduction in resistant HTN (Class 1) - Requires eGFR ≥45 mL/min (check K+ closely) - Typical dose: 12.5-25 mg daily

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Primary Aldosteronism

New Guideline: Universal screening in resistant HTN regardless of potassium status (Class 1)

Rationale: 70-80% of primary aldosteronism is normokalemic; old practice missed most cases.

Screening Test: Morning seated aldosterone-to-renin ratio (ARR)

Treatment: Mineralocorticoid receptor antagonist (spironolactone/eplerenone) reduces CV risk beyond BP control alone.

Hypertension in Pregnancy

Classification: - Normal: <120/80 mmHg - Elevated: 120-129/<80 - Stage 1 HTN: 130-139/80-89 - Stage 2 HTN: ≥140/90 - **Hypertensive crisis (urgent treatment): ≥160/110**

Treatment Thresholds (CHAP Trial): - Treat chronic HTN ≥140/90 mmHg in pregnancy (Class 1) - Advantages: 25% reduction in preeclampsia, no increased fetal risk

Preferred Medications: 1. **Methyldopa** – gold standard (safest long-term) 2. **Labetalol** – excellent (avoid in asthma) 3. **Extended-release nifedipine** – safe alternative

Contraindicated (Teratogenic/Harmful): - ACE inhibitors, ARBs (2nd/3rd trimester teratogenesis) - Atenolol (intrauterine growth restriction) - Enalapril, lisinopril, etc. - Spironolactone (anti-androgenic)

Hypertensive Emergency in Pregnancy: - SBP ≥160/110 mmHg requires **urgent IV treatment within 30-60 minutes** - Goal: Reduce by 10-15% initially, then to 140-150 mmHg (avoid excessive reduction□placental hypoperfusion) - Agents: IV labetalol, IV hydralazine, sublingual nifedipine (NOT immediate-release)

Section 5: 2025 Guideline Innovations

Potassium-Based Salt Substitutes (NEW)

Class 2a recommendation for agents containing 25% KCl / 75% NaCl

Evidence (SSaSS Trial): - 3.34 mmHg systolic reduction - 13% stroke risk reduction - Dual benefit: ☐ Na+, ☐ K+

Contraindications: - eGFR <30 mL/min (hyperkalemia risk) - Concurrent potassium-sparing diuretics or RAAS inhibitors (additive HK risk) - Baseline hyperkalemia

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Renal Denervation (Class 2b)

Candidates: - Office SBP 140-180 mmHg despite adherence - eGFR ≥40 mL/min - No significant renal artery abnormalities - Multidisciplinary team evaluation required

Efficacy: 5-10 mmHg office SBP reduction (modest); 30-40% non-responders; durability uncertain.

Clinical Pearl: Not a replacement for pharmacotherapy; combined with optimal medications for best outcomes.

Section 6: Clinical Pearls & Practice Points

Measurement & Diagnosis

- **Exclude white coat HTN** before treating Stage 1: use ABPM/HBPM for office BP 130-159/80-99
- **Screen for masked HTN** in patients with normal office BP + target organ damage
- **Morning surge** (>35 mmHg) independently predicts stroke risk beyond mean BP

Drug Selection

- **ACEI cough?** Switch to ARB (avoids recurrence)
- **Losartan for gout:** unique uricosuric effect
- **Chlorthalidone over HCTZ:** superior potency and duration
- **Avoid dual RAAS blockade:** increased AKI, HK, hypotension (Class 3 Harm)

Special Scenarios

- **Diabetes + albuminuria:** RAAS inhibitor mandatory (even microalbuminuria)
- **CKD stages 4-5:** Anticipate prolonged ACE-I half-life if future ARNI transition needed
- **Resistant HTN:** Screen for primary aldosteronism universally (regardless of K+)
- **Wide pulse pressure (PP >60 mmHg):** Avoid DBP <60 mmHg (increases coronary events in CAD)

Target Organ Monitoring

- Check eGFR, K+ 1-2 weeks after RAAS inhibitor
- Annual urine ACR in diabetes/CKD
- Consider ABPM annually in high-risk patients even if controlled
- Renal ultrasound if eGFR decline >30% in 3 months

Practice Questions

Question 1: A 52-year-old woman has office BP 138/87 mmHg with no symptoms. She is not on medications. Home BP monitoring over 7 days (after discarding day 1) averages 127/78 mmHg. What is the most appropriate next step?

A) Initiate monotherapy with amlodipine
B) Diagnose white coat hypertension; counsel on lifestyle modification and reassess in 3-6 months
C) Obtain ABPM to confirm
D) Begin chlorthalidone for BP control

Answer: B – Office BP 138/87 with home BP <130/80 defines white coat HTN. Lifestyle modification with reassessment in 3-6 months is Class 2a recommended; ABPM is optional confirmatory testing.

Question 2: A 68-year-old man with type 2 diabetes (HbA1c 7.2%) and CKD stage 3b (eGFR 38) has BP 142/88 despite lisinopril 10 mg daily. Serum K+ 5.2 mEq/L. Which medication would you add next?

A) Spironolactone 12.5 mg for resistant HTN
B) Hydrochlorothiazide 12.5 mg
C) Amlodipine 5 mg
D) Increase lisinopril to 20 mg

Answer: C – Amlodipine is appropriate second-line; avoids further K+ elevation (given borderline hyperkalemia and RAAS inhibitor). Spironolactone inappropriate here (baseline HK). HCTZ less preferred than chlorthalidone/indapamide. Increasing ACEI would worsen HK.

Question 3: A 44-year-old woman in her second trimester with chronic hypertension (BP 148/92 mmHg) is currently on lisinopril. What is the most appropriate management?

A) Continue lisinopril; it is safe throughout pregnancy
B) Switch to methyldopa or labetalol immediately
C) Obtain obstetric consultation and initiate treatment if risk of preeclampsia >10%
D) Defer treatment until third trimester

Answer: B – ACE inhibitors are teratogenic in 2nd/3rd trimester (enalapril-associated renal dysgenesis). Switch to methyldopa or labetalol. Treatment threshold is ≥140/90 per CHAP trial (Class 1), so treatment is indicated.

See Also

Related Student Handouts

- Secondary Hypertension
- Blood Pressure Measurement
- IV Antihypertensives for Hypertensive Urgency/Emergency
- CKD Complications
- Cardiorenal Syndrome

Clinical Content (01-Clinical-Medicine/Nephrology & Cardiology)

- Hypertension Management Hub
- Cardio-Renal Ecosystem Hub
- Essential Renal Laboratory Tests

Butler-COM Resources

- Butler COM - Nephrology Deep Dive

Key References

- 2025 AHA/ACC/AANP/AAPA Hypertension Guideline
- Hypertension Management Evidence Based Report
- Oscillometric Blood Pressure Measurement Clinical Applications
- Home Blood Pressure Monitoring Patient Guide

Created for PA/Medical Student Education *Last Updated: 2026-02-12*

Clinical Resources

- Clinical Review: Hypertension Management Patient Bp Monitoring Guide — Comprehensive clinical review with PubMed references
- Clinical Review: Renovascular Hypertension Review — Comprehensive clinical review with PubMed references
- Clinical Review: Hypertension Management Report — Comprehensive clinical review with PubMed references