Essential Hypertension

Hypertension Guideline Team

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Patient population: Adults age 18 and older.

Objectives: (1) Accurately diagnose hypertension. (2) Improve blood pressure (BP) control. (3) Decrease hypertension-related morbidity and mortality. (4) Encourage patient's self-involvement. (5) Provide appropriate education and follow-up. (6) Provide cost-effective care.

Key aspects and recommendations:

- **Diagnosis**

- Although a single, carefully taken blood pressure (BP) reading may predict future cardiovascular risk, for clinical purposes this risk is better identified by taking the mean BP level from recordings over several visits.
- Home or ambulatory blood pressure monitoring helps improve BP control and identifies "white coat" and "masked" hypertension *[IIA]**.
- If home BP monitoring is used, be sure the BP monitor is carefully calibrated. Educate patients on proper technique.
- If mean BP > 135/80, screen for diabetes *[IB]*.
- National and international guidelines vary on how they define hypertension. Continue to classify office BP readings consistent with JNC 7 (Table 4), until there is greater consensus regarding the new definitions proposed by the 2017 ACC/AHA guidelines.

- **Treatment**

  - Incorporate patient's risks and values using shared decision-making to tailor BP management *[ID]*.
  - Blood pressure treatment targets for adults of any age:
    - Without risk: < 140/90 mm Hg with no clinical risk: no clinical atherosclerotic cardiovascular disease (ASCVD), 10-year ASCVD risk score < 10%, and no chronic kidney disease (CKD), *[IA]*. (Note: diabetes is already considered in calculating ASCVD risk.)
    - With ASCVD, ASCVD risk > 10%, or CKD:
      - <130/80 mm Hg if without risk for hypotension (eg, without: orthostatic hypotension, heart failure, older age). *(SBP of < 130 mm Hg ([IA] for ASCVD; DBP < 80 mm Hg [IA].)*
      - Consider <140/90 mm Hg if risk for hypotension
  - Additionally, for CKD stages 3b-5, monitor more frequently due to increased risk for hyperkalemia.
  - Treatment of SBP over 160 mm Hg is important in reducing CVA and CHF risk *[IA]*.
  - Lifestyle modifications (eg, weight management, diet and sodium restrictions, physical activity, alcohol moderation, tobacco avoidance) are important initial treatment steps to lower BP *[IA]*.
  - Begin drug therapy with a thiazide diuretic, ACE inhibitor, ARB, or long-acting dihydropyridine calcium channel blocker for almost all patients. Add second and third agents as needed to achieve effective BP reduction goals *[IA]*.
    - Specific illnesses may guide the initial and subsequent choice of agents, eg:
      - ACE inhibitors (ARB for those unable to tolerate ACE inhibitors) for patients with renal disease, diabetes with either micro- or macroalbuminuria, or left ventricular (LV) dysfunction
      - Beta-blockers for those with CAD or CHF.
  - Over 70% of individuals require two or more drugs to achieve BP goals. A fixed combination therapy may be cost-effective. Once a day medications increase compliance and are preferred.

*** Strength of recommendation:**
I= generally should be performed; II = may be reasonable to perform; III = generally should not be performed.
Levels of evidence for the most significant recommendations
A = randomized controlled trials; B=controlled trials, no randomization; C=observational trials; D=opinion of expert panel

Clinical Background

Incidence

Forty-three million United States adults have hypertension, representing 24% of the U.S. adult population; 20 million have no medication prescribed, and 12 million are on medication but not controlled. Thus, about one out of four hypertensive patients are adequately controlled. Uncontrolled hypertension results in end stage organ damage, which leads to significant mortality and morbidity.

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Table 1. Selection of Initial and Subsequent Antihypertensive Drug(s) Based on Concurrent Disease States

Coexisting Condition	Disease Specific Agent*	Relatively Contra-indicated Agents**	Comments
Cardiovascular			
Angina	β blocker; ACEI if LV dysfunction		Short-acting DHP CCBs are relatively contraindicated for all coronary artery disease.
MI History	β blocker, ACEI		
CHF – Systolic	ACEI, β blocker; ARB if ACEI not tolerated, aldosterone inhibitor	Non-DHP CCB, alpha blocker	HYD and nitrate if ACEI and ARB not tolerated β blockers should be used in very low dosages and slowly titrated.
Cardiomyopathy (Hypertrophic)	β blocker, non-DHP CCB	diuretic, ACEI & ARB, α1 blocker, DHP CCB	
Tachycardia (Supra-ventricular)	β blocker, non-DHP CCB		
Bradycardia/heart block		β blocker, Non-DHP CCB, α2 agonist	
Aortic/Mitral Regurgitation	ACEI, DHP CCB, ARB if ACEI not tolerated		
Metabolic			
Diabetes	ACEI, ARB		Concerns that thiazide diuretics and β blockers may worsen glucose control and β blockers may mask hypoglycemia have largely been refuted as clinically insignificant
Gout	losartan is uricosuric		Diuretic-induced hyperuricemia does not require treatment in absence of gout or kidney stones. Even with these, diuretics may be restarted if uric acid is controlled to < 6 mg/dl with allopurinol.
Renal Disease			
Chronic Renal	ACEI, ARB if ACEI not tolerated	DHP CCB (alone)	Avoid potassium-sparing agents due to increased risk of hyperkalemia. Loop diuretics preferred if creatinine is ≥ 2.5 (GFR < 30 ml/min).
GU			
Impotence	ACEI (ARB if ACEI not tolerated), DHP CCB		
Bilateral (or equivalent) Renal Artery Stenosis	β blocker, DHP CCB	ACEI and ARB	
Pulmonary			
Reactive Airway Diseases			β blockers should be started at low dose and slowly titrated.
Psychiatric/CNS			
Headaches (Vascular)	β blocker, non-DHP CCB		Verapamil (not diltiazem) useful for cluster headaches and, to lesser extent, migraines.
Pregnancy			
	methyldopa, β blocker (except atenolol and propranolol), calcium channel blocker, labetalol, hydralazine	atenolol, propranolol ACEI, ARB	ACEI and ARB are absolutely contraindicated.
Drug Interactions			
Cyclosporine HTN	β blocker, DHP CCB		
Lithium Usage	β blocker, DHP CCB, Non-DHP CB	Diuretics, ACEI and ARB	Thiazides may increase level by 25-40%. Potassium sparing diuretics have minor effects.

* Antihypertensive Drug Classes	Abbreviations	Antihypertensive Drug Classes (cont.)	Abbreviations
Alpha 1 blocker	α1 blocker	Direct vasodilator	NA
Angiotensin converting enzyme inhibitor	ACEI	Diuretic	NA
Angiotensin II receptor antagonist	ARB	Hydralazine	HYD
Beta blocker	β blocker	Isosorbide dinitrate	ISDN
Centrally acting alpha-2 agonist	NA	Non-dihydropyridine calcium channel blocker (eg-diltiazem, verapamil).	Non-DHP CCB
Dihydropyridine calcium channel blocker (eg, amlodipine, felodipine)	DHP CCB		

** May still be used under certain circumstances

Table 2. Antihypertensive Medications: Common Doses and Costs

Drug Class (generic name)	Brand Name	Usual Dosage Regimens				30 Day Cost*	
						Generic	Brand
Thiazide Diuretics							
hydrochlorothiazide	generic		12.5mg.daily	25mg daily	50 mg daily	$5-7	n/a
chlorthalidone	generic				25 mg daily	$19	n/a
Potassium Sparing/Thiazide Combination Diuretics							
amiloride /HCTZ**	generic				5 mg/50 mg daily	$19	n/a
triamterene/HCTZ	Dyazide				37.5 mg/25 mg daily	$9	$70
spironolactone/HCTZ	Aldactazide				25 mg/25 mg daily	$35	$85
ACE Inhibitors							
captopril	Capoten		12.5 mg 2x/day	25 mg 2x/day	50 mg 3x/day	$44-109	$93-235
benazepril	Lotensin	5 mg daily	10 mg daily	20 mg daily	40 mg daily	$6-7	$29 all
quinapril	Accupril		10 mg daily	20 mg daily	40 mg daily	$9-20	$157 all
lisinopril	Prinivil/Zestril	5 mg daily	10 mg daily	20 mg daily	40 mg daily	$4-5	$26-43
enalapril	Vasotec	2.5 mg daily	5 mg daily	10 mg daily	10 mg 2x/day	$13-20	$12-40
fosinopril	Monopril		10 mg daily	20 mg daily	40 mg daily	$9 all	$32 all
trandolapril	Mavik		1 mg daily	2 mg daily	4 mg daily	$11-15	$34 all
moexipril	Univasc			7.5 mg daily	15 mg daily	$30 all	$38-40
ramipril	Altace		2.5 mg daily	5 mg daily	10 mg daily	$6 all	$193-237
perindopril	Aceon			4 mg daily	8 mg daily	$20-22	$62-76
ACE Inhibitor / Diuretic Combinations							
benazepril/HCTZ	Lotensin HCT	5 mg/6.25 mg daily	10 mg/12.5 mg daily		20 mg/12.5mg daily	$23-52	$56 all
lisinopril/HCTZ	Prinzide/Zestoretic	10 mg/12.5 mg daily	20 mg/12.5 mg daily		20 mg/25 mg daily	$5 all	$30-33
fosinopril/HCTZ	Monopril HCT		10 mg/12.5 mg daily		20 mg/12.5 mg daily	$38 all	$83 all
quinapril/HCTZ	Accuretic	10 mg/12.5 mg daily	20 mg/12.5 mg daily		20 mg/25 mg daily	$22-25	$153 all

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Table 2. Antihypertensive Medications: Common Doses and Costs, continued

Drug Class (generic name)	Brand Name	Usual Dosage Regimens			30 Day Cost* Generic	30 Day Cost* Brand
Angiotensin Receptor Blockers						
telmisartan	Micardis		40 mg daily	80 mg daily	$18 all	$233 all
olmesartan	Benicar		20 mg daily	40 mg daily	$15-16	$238-330
valsartan	Diovan	80 mg daily	160 mg daily	320 mg daily	$13-19	$254-346
irbesartan	Avapro		150 mg daily	300 mg daily	$10-13	$194-234
candesartan	Atacand	8 mg daily	16 mg daily	32 mg daily	$53 all	$216-294
eprosartan	Teveten		400 mg daily	600 mg daily	$95	$95
losartan	Cozaar	50 mg daily	100 mg daily	50 mg 2x/day	$6-9	$163-240
azilsartan	Edarbi		40 mg daily	80 mg daily	n/a	$202-220
Angiotensin Receptor Blocker / Diuretic Combinations						
valsartan/HCTZ	Diovan HCT		80 mg/12.5 mg daily	160 mg/12.5 mg daily	$10	$225-286
telmisartan/HCTZ	Micardis HCT	40 mg/12.5 mg daily	80 mg/12.5 mg daily	80 mg/25 mg daily	$53	$233
candesartan/HCTZ	Atacand HCT		16 mg/12.5 mg daily	32 mg/12.5 mg daily	$92-104	$243-264
losartan/HCTZ	Hyzaar		50 mg/12.5 mg daily	100 mg/25 mg daily	$8	$25-181
olmesartan/HCTZ	Benicar HCT	20 mg/12.5 mg daily	40 mg/12.5 mg daily	40 mg/25 mg daily	$106	$330
eprosartan/HCTZ	Teveten HCT		600 mg/12.5 mg daily	600 mg/25 mg daily	n/a	$152
azilsartan/CTD	Edarbyclor		40 mg/ 12.5mg daily	40 mg/12.5mg daily	n/a	$207
Calcium Channel Blockers						
Non-DHP						
verapamil SR	Calan SR			240 mg daily	$10	$287
diltiazem	Cardizem	30 mg 4x/day	60 mg 3x/day	60 mg 4x/day 90 mg 3x/day	n/a	$322-378
diltiazem CD	Cardizem	120 mg daily	180 mg daily	240 mg daily 300 mg daily	$16-23	$1017-1805
DHP (dihydropyridines)						
amlodipine	Norvasc		5 mg daily	10 mg daily	$6	$50-65
felodipine	Plendil		5 mg daily	10 mg daily	$9-10	$43-100
nifedipine CC	Adalat CC Procardia XL	30 mg daily	60 mg daily	90 mg daily	$18	$103-120
nisoldipine	Sular	20 mg daily	30 mg daily	40 mg daily	$450	$484
isradipine CR	Dynacirc CR		5 mg daily	10 mg daily	$50-96	$54-108

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Table 2. Antihypertensive Medications: Common Doses and Costs, continued

Drug Class (generic name)	Brand Name	Usual Dosage Regimens			30 Day Cost*	
					Generic	Brand
Calcium Channel Blocker / ACE Inhibitor Combinations						
amlodipine/benazepril	Lotrel	2.5mg/10mg daily	5mg/10mg daily	5mg/20mg daily	$12-13	$73-78
trandolapril/verapamil	Tarka	1mg/240mg	2mg/180mg 2mg/240mg	4mg/240m all daily	$130 all	$194 all
Aldosterone Antagonists						
spironolactone	Aldactone		25 mg daily	50 mg daily	$6-10	$82-144
eplerenone	Inspra		50 mg daily	50 mg 2x/day	$56-110	$117-234
Beta Blockers						
atenolol	Tenormin	25 mg daily	50 mg daily	100 mg daily	$6-7	$22-40
propranolol	Inderal LA Inderal XL	60 mg daily	80 mg daily	120 mg daily	$22-35	$815 all
labetalol	Trandate/Normodyne	100 mg 2x/dy	200 mg 2x/day	300 mg 2x/day	$20-24	$56-108
nadolol	Corgard	40 mg daily	80 mg daily	160 mg daily	$43-121	$163-450
metoprolol tartrate	Lopressor		50 mg 2x/day	100 mg 2x/day	$7	$94-124
metoprolol succinate	Toprol XL Bystolic	2.5 mg daily	100 mg daily 10-20 mg daily	200 mg daily 40 mg daily	$10-23	$62-96 $155-309
nebivolol	Coreg	3.125 mg 2x/day	12.5-25 mg 2x/day	25 mg 2x/day	$8-9	$57 all
carvedilol	Coreg CR	10 mg daily	20 mg daily 40 mg daily	80 mg daily	$217	$280
Direct Vasodilators						
hydralazine	generic	25 mg 3x/day	50 mg 3x/day	100 mg 3x/day	$12-19	n/a
minoxidil	generic		5 mg 2x/day	20 mg 2x/day	$26-48	n/a
Centrally-acting alpha-2 agonists						
clonidine	Catapres		0.1 mg 3xday	0.3 mg 3x/day	$9-10	$264-507
methyldopa	generic	25 mg 3x/day	500 mg 3x/day	1000 mg 3x/day	$89	n/a
Alpha Blockers						
doxazosin	Cardura	1 mg daily	2 mg daily	4 mg daily	$10-12	$150-158
terazosin	Hytrin	1 mg daily	2 mg daily	5 mg daily	$8 all	$43 all
prazosin	Minipress	1 mg 2x/day	2 mg 2x/day	5 mg 2x/day	$38-56	$142-337
Renin Inhibitors						
aliskiren	Tekturna		150 mg daily	300 mg daily	$192-258	$207-320
Other Diuretics						
torsemide	Demadex		5 mg daily	10 mg daily	$10-12	$17-19
(Furosemide –generic or Lasix – has no blood pressure indication, only volume control.)						

* Pricing information for brand drugs, Average Wholesale Price minus 10%. AWP from Lexicomp Online 07/2019. For generic drugs, Maximum Allowable Cost plus $3 from BCBS of Michigan MAC List, 07/2019.

** HCTZ = hydrochlorothiazide, CTD = chlorthalidone

Table 3. Errors in Measurement of Blood Pressure

Faulty Technique	Patient Related	No effect on BP readings
• Back not supported	• Pseudo-hypertension	• Menstrual phase
• Arm not supported	• Atrial fibrillation	• Chronic caffeine ingestion
• Elbow too high	• Pain or anxiety	• Phenylephrine nasal spray
• Elbow too low	• Acute smoking	• Cuff self-inflation
• Missed auscultatory	• Acute caffeine (< 30 min.)	• Examinee and examiner discordance in sex or race
• Feet not on ground	• Acute ethanol (< 2 hours)	• Bell vs diaphragm of stethoscope
Faulty BP Equipment	• Talking during BP reading	• Room temperature
• Gauge inaccurate		• Thin shirtsleeve under cuff (growing evidence, not universally endorsed)
• Cuff not correct size		

Table 4. Classification of Office BP Readings (JNC 7)

Category	Systolic	Diastolic
Normal	< 120	and < 80
Prehypertension	120-139	or 80-89
Hypertension		
• Stage 1	140-159	or 90-99
• Stage 2	≥ 160	or ≥ 100

Table 5. Reversible Causes of Sustained Elevated Blood Pressure Readings

Medications:	**Medications** (continued):	**Lifestyle factors**	**Diet**
• NSAIDs *	• appetite suppressants	• alcohol > 2 drinks/day	• High sodium (esp. elderly or African-American)
• oral contraceptive agents	• antidepressants	• sedentary lifestyle	
• glucocorticoid or mineralocorticoid steroids	• MAO inhibitors	**Illicit drugs**	**Associated Conditions**
	• cyclosporine	• cocaine	• Sleep apnea
* interferes with antihypertensive medications	• erythropoietin	• amphetamines	
		• anabolic steroids	

Rationale for Recommendations

Recommendations are organized under headings for:

- Diagnosis of hypertension
- Initial evaluation of newly diagnosed patient
- Treatment of hypertension
- Monitoring blood pressure control

Diagnosis of Hypertension

Performing BP measurement. BP readings need to be performed accurately to provide useful information. BP in the office should be checked after 5 minutes of sitting quietly in a chair, with feet on the floor, and arm supported at the heart level, and the results recorded on the medical record. Standardizing the use of the same arm by all staff can facilitate comparisons for sequential measurement. The choice of which arm does not matter if at the initial measurement there are no differences between blood pressures taken on both sides. Caffeine, exercise, and smoking should be avoided for at least 30 minutes prior to measurement. (See Appendix for detail about devices and proper technique.) Patients should be informed of the readings, interpretation and necessary follow-up if indicated. If available, automated office BP measurement is preferred to non-automated BP measurement in the office. Elevated BP in the office should be confirmed with home BP measurement, which is described in more detail below.

Although a single, carefully taken BP reading may predict future cardiovascular risk, risk is better identified by taking the mean BP level from recordings over several visits.

Frequency of BP screening. Frequency depends on patient risk status regarding hypertension.

- If BP is normal (< 120/80), measure BP at least annually (current expert opinion). Consider BP measurement at every visit.
- If BP is in the prehypertension range (120-139 / 80-89 mm Hg), measure BP every 6 months.
- If the BP average is ≥ 140/90, consider assessing for and correcting reversible causes of hypertension (Table 5). Aortic regurgitation may be a cause of isolated systolic hypertension.

HTN classification and follow-up assessment. National and international guidelines vary in how they define hypertension. Continue to classify the average initial BP readings according to JNC 7 expert opinion guidelines (Table 4) until there is greater consensus.

The 2017 Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults by the American College of Cardiology (ACC)/American Heart Association (AHA) defines hypertension as ≥ 130/80. However, Hypertension Canada's 2018 Guidelines for Diagnosis, Risk Assessment, Prevention, and Treatment of Hypertension in Adults and Children and the 2018 European Society of Cardiology (ESC) and European Society of Hypertension (ESH) Joint Guidelines for the Management of Arterial Hypertension continue to define HTN as ≥ 140/90 in the office. All guidelines stress the significance of BP ≥ 130/80 in those with increased risk.

BP monitoring. BP can be monitored at home in two ways.

- Home blood pressure monitoring (HBPM) – Patient or caregiver records blood pressures at home with a blood pressure cuff. This requires knowledge and training in proper technique. Upper arm BP cuffs are preferred, since wrist and finger monitors are not reliable. Proper technique and calibration of home BP cuffs should be verified in a clinic setting if HBPM is to be utilized for clinical decision making.
- Ambulatory blood pressure monitoring (ABPM) – Automated cuff sent home from the clinic, worn for a pre-specified period of time (usually 24 hours). It is expensive, but is reliable and has been shown to be an independent predictor of cardiovascular morbidity and mortality when added to office based BP measures.

HBPM and ABPM identify patients whose BP at clinic visits differs from BP outside the office. They may also be useful in resistant hypertension.

- White coat hypertension (WCH) refers to patients with elevated BP at office visits, but normal BP outside the office. This condition is common (> 20% of patients with elevated BP) and may result in overtreatment if unrecognized. Both HBPM and ABPM can help identify WCH. Documentation of WCH results in decreased drug cost, with no change in LV mass, cardiovascular outcomes, or well-being. WCH may carry a higher long term risk of hypertension, but at least one study has not shown an increase in risk.
- Masked hypertension refers to patients with target BP at clinic, but elevated home BP. This condition may be nearly as common as WCH. These patients may have LVH or other target organ damage despite normal office BP. Both HBPM and ABPM can help identify masked hypertension, resulting in more aggressive medication regimens and improved cardiovascular outcomes.

Currently, reimbursement for ABPM by Medicare is covered only for suspected WHC, defined by 3 or more office visit BPs > 140/90 mm Hg, at least two documented BPs outside the office < 140/90 mm Hg, and no evidence of target organ damage.

Initial Evaluation of Newly Diagnosed Patients

History. Once the diagnosis of hypertension is made, the clinician should determine by history and physical examination whether the patient has evidence suggesting secondary hypertension, as well as other cardiovascular risk factors. The history should focus on the following:

- Cardiovascular review of systems, including known duration of hypertension
- Symptoms or previous personal/family history that helps to identify secondary hypertension
- Presence or absence of other cardiovascular risk factors
- Psychosocial and environmental factors that may influence BP control
- Medications being taken

Physical examination. Based on expert opinion the JNC 7 recommendations for the physical examination of hypertensive patients are:

- Two or more BP measurements separated by 2 minutes with the patient either supine or seated
- Verification in the contralateral arm
- Body mass index (BMI), calculated by weight (kg)/ [height (m)]^2 (possibly waist circumference)
- Funduscopic examination for arteriolar narrowing, nicking, hemorrhages, exudates, etc.
- Neck examination for carotid bruits, distended veins, or enlarged thyroid
- Heart/lung examination
- Abdominal examination for enlarged kidneys, masses, distended bladder, renal bruits, aortic aneurysm
- Extremity examination for pedal pulses and edema
- Neurological assessment, particularly for signs of cerebrovascular disease

Laboratory tests and diagnostic procedures.

Essential hypertension. Consider the following tests before therapy is initiated. Screening for diabetes is particularly important.

- Blood glucose
- Creatinine
- Calcium
- EKG
- Hematocrit
- Lipid panel
- Potassium
- Urinalysis

Secondary and/or complicated hypertension. Consider other testing and/or referral when secondary hypertension or complicated hypertension (does not respond to usual measures, pre-existing controlled hypertension becomes uncontrolled, sudden onset of hypertension, and/or malignant hypertension) is suspected. History and the above laboratory screening may be helpful in detection.

Secondary hypertension and complicated hypertension etiologies include:

- Chronic or acute kidney disease
- Renovascular hypertension
- Sleep apnea
- Medications or illicit drugs
- Chronic kidney disease
- Renovascular disease
- Primary aldosteronism
- Coarctation of the aorta
- Chronic steroid therapy and Cushing's syndrome
- Pheochromocytoma
- Thyroid or parathyroid disease

Medications and other reversible causes are described further in Table 5.

Risk Stratification. The risk of cardiovascular disease in patients with hypertension is determined not only by the level of BP but also by the presence or absence of target organ damage:

Current diagnoses:

- LVH
- CHF
- Angina
- Stroke or TIA
- Chronic kidney disease (includes microalbuminuria or proteinuria)
- Peripheral arterial disease
- Retinopathy

History of:

- MI
- CABG
- CVA
- TIA

Other risk factors:

- Smoking
- Obesity (BMI ≥ 30 kg/m^2)
- Physical inactivity
- Dyslipidemia
- Diabetes
- Estimated GFR < 60 mL/min)
- Age (> 55 for men, > 65 for women)
- Family history of premature cardiovascular disease (men < 55 or women < 65) disease

Treatment of Hypertension

Treatment BP goal. The target BP depends on the presence of other risk factors.

Without ASCVD, ASCVD 10-year risk < 10%, and no CKD, treatment target is SBP < 140 mm Hg and DBP < 90 mm Hg. ASCVD risk is based on the ACC/AHA pooled cohort ASCVD risk calculator.

With ASCVD, ASCVD 10-year risk ≥ 10%. Or CKD:

- <130/80 mm Hg if without risk for hypotension (eg, without: orthostatic hypotension, heart failure, older age).
- Consider <140/90 mm Hg if risk for hypotension.

For CKD stages 3b-5, monitor more frequently due to increased risk for hyperkalemia.

Age is an important factor in the ACC/AHA ASCVD risk calculator, resulting in a BP target of <130/80 mm Hg for most older adults. Even with normal values for blood pressure, cholesterol, and a history of no smoking, men age ≥ 60 years and women age ≥ 70 years will have a calculated 10-year ASCVD risk ≥ 10%. Individualizing BP treatment goals is particularly important for older adults for whom treatment to < 130/80 mm Hg may result in other clinical concerns (eg, hypotension and its risks).

Diabetes is another important factor in the ACC/AHA ASCVD risk calculator, resulting in a BP target of < 130/80 for most patients with diabetes. Having diabetes essentially doubles an individual's risk that results from other factors. Even with normal values for blood pressure, cholesterol, and a history of no smoking, with diabetes men age ≥ 55 years and women age ≥ 65 years will have a 10-year ASCVD risk > 10%. Many middle-age adults and some younger adults with diabetes and with other risk factors for ASCVD will have a calculated 10-year ASCVD risk > 10%.

For patients at risk for hypotension (eg, orthostatic hypotension, heart failure, older age), consider a treatment target of SBP < 140 mm Hg and DBP < 90 mm Hg. The BP target is higher to avoid hypotension, which may result in insufficient blood flow to organs (eg, kidneys in patients with CKD), dizziness, and fainting. The prevalence of orthostatic hypotension increases with age, from 4% for individuals age 50-59 years to 19% for individuals over 80 years. See the UMHS Heart Failure guideline for more detail on this topic.

Patients with CKD stages 3b-5 should be monitored more frequently for hyperkalemia. Commonly prescribed hypertension medications (eg, angiotensin converting enzyme inhibitors, angiotensin receptor blockers, potassium-sparing diuretics) may result in hyperkalemia in patients with decreased renal function.

Clinical trial data reviewed by the Seventh Report of the Joint National Committee (JNC 7) support reducing SBP to < 140 mm Hg and DBP to < 90 mm Hg. This was confirmed by the panel members of the Eighth Joint National Committee for ages 60 years and younger. For ages 60 years and over, the latter recommended reducing SBP to < 150 mm

Hg and DBP to < 90 mm Hg. The 2017 ACC/AHA guidelines recommended reducing SBP to < 130 mm Hg and DBP to < 80 mm Hg, based on new data from SPRINT. Systolic blood pressure had not been evaluated as rigorously as diastolic blood pressure until SPRINT looked at SBP control and clinical outcomes. For patients with elevated blood pressure and elevated ASCVD risk, aggressive treatment of HTN provides significant improvements in clinical outcomes. Current available data suggest that a SBP target of < 130 mm Hg is reasonable.

Guidelines from outside the United States, including Hypertension Canada 2018 Guidelines and the 2018 ESC/ESH Guidelines recommend target SBP of < 140 mm Hg and DBP of < 90 mm Hg for adults without risk, and target SBP of < 130 mm Hg and DBP of < 80 mm Hg for adults with risk.

In all guidelines, accurate BP measurement using automated office BP or home BP measurement was recommended. A sustained decrease in SBP of 10 mm Hg or DBP of 5-6 mm Hg for patients with hypertension decreases the risk of stroke by 35-40% and decreases the chance of coronary heart disease by 20-25%.

For patients with diabetes, goals for blood pressure treatment have been evaluated in several randomized trials, particularly ACCORD. SPRINT did not evaluate diabetic patients. For DBP, a target of 90 and likely 80 mm Hg provides marked benefits. Caution is suggested when DBP falls below 70 mm Hg. Mortality increased when patients with diabetes had DBP below 70.

The American Diabetes Association's 2019 Standards for Medical Care in Diabetes synthesize results from ACCORD and SPRINT by focusing on diabetes as a risk factor for ASCVD. The ADA recommends that BP targets for patients with diabetes be based on the patient's ASCVD status and 10-year risk for ASCVD, consistent with the ACC/AHA approach to setting BP targets based on ASCVD and ASCVD risk. The one difference is that for a BP target of < 130/80 mm HG, ACC/AHA set 10-year ASCVD risk level at ≥ 10% and the ADA set the level at ≥ 15%. This difference is of little practical consequence. The effect of increasing age on the calculation of ASCVD risk is sufficiently strong than anyone with an estimated 10-year risk that is > 10% and < 15% will have an estimated risk ≥ 15% within a couple of years. Using 10-year ASCVD risk level of ≥ 10% initiates lowering the goal to < 130/80 mm HG slightly earlier.

For CKD, the "Kidney Disease: Improving Global Outcomes" (KDIGO) group in 2012 recommended BP targets for patients with CKD of < 140/90 mm Hg if urine albumin excretion is < 30 mg per 24 hours and of < 130/80 mm Hg if urine albumin excretion is ≥ 30 mg per 24 hours. KDIGO is reviewing its recommendations based on the results of SPRINT, which included CKD patients. Based on the results of SPRINT, our recommendation is also to apply the target of 130/80 mm Hg to CKD patients with urine albumin excretion < 30 mg per 24 hours. We add practical precautions to avoid hypotension and to monitor for hyperkalemia.

Treatment selection. While lifestyle modification is always recommended, the addition of medications depends on disease severity and other risk factors.

Patients with prehypertension but without risk factors or target organ damage (TOD) should have lifestyle modification recommended.

Patients with Stage 1 hypertension and no other risk factors can be recommended for a trial of lifestyle modification for up to 12 months. With recent evidence suggesting that early treatment to target blood pressure levels may attenuate the expression of hypertension and improve clinical outcomes, more experts are recommending both medication and lifestyle modification initially, with plans to reduce or eliminate drug therapy as lifestyle goals are achieved.

Patients with Stage 2 hypertension or with either diabetes, or any TOD should have drug therapy in addition to lifestyle modification. Initial combination therapy with a thiazide plus an additional agent is useful (or other combinations). Additionally, patients that are felt to have resistance to prior therapy or possibly less compliant may achieve better control with initial combination therapy.

Lifestyle modifications. Clinical trials have shown that lifestyle modifications can lower BP. Lifestyle modifications are best initiated and sustained through an educational partnership between the patient and a multidisciplinary health care team. While team members may vary by clinical setting, behavior-change strategies should include nutrition, exercise, and smoking cessation services.

Weight reduction and maintenance. Many individuals who are both overweight and hypertensive can lower their BP with weight reduction. The effect is usually evident in the early stages of weight loss and frequently occurs with only a ten-pound reduction in weight.

Modification of dietary sodium. The current recommendation is to lower sodium intake to less than 2.4 grams per day. Encourage patients to lower their sodium intake by not adding salt to their food or in cooking; limiting processed, convenience, or fast foods; and reading food labels for sodium content. Water softeners contribute sodium to the water and may be significant.

Moderation of alcohol intake. Patients should not exceed a daily alcohol intake of 1 ounce of ethanol. This amount is contained in 2 ounces of 100 proof whiskey, 8 ounces of wine, or 24 ounces of beer.

Adequate physical activity. Regular aerobic physical activity may be beneficial for both prevention and treatment of hypertension. It may enable weight loss, improve functional health status, and diminish mortality and risk for

cardiovascular disease. Thirty to forty-five minutes of brisk walking three or four times weekly is adequate and effective. Resistive isotonic activities as sole exercise are not recommended to lower BP in hypertensive patients.

Tobacco avoidance. All smokers should be offered assistance in smoking cessation and strongly advised to quit.

Potassium. High dietary potassium may protect against hypertension development. Hypokalemia may exacerbate hypertension and induce ventricular arrhythmia. Potassium sparing diuretics and ACE inhibitors retain potassium and magnesium whereas simple potassium chloride replacement does not replace magnesium.

Other dietary factors. Calcium supplementation may result in a very small reduction in BP (systolic -1.27 mm Hg; diastolic -0.24 mm Hg). No definitive data suggest magnesium supplementation lowers blood pressure. Dietary fats have no effect on blood pressure. Acute caffeine ingestion may elevate BP; however, tachyphylaxis to chronic ingestion attenuates this effect. A diet low in sodium and saturated fats, and high in vegetables, fruits, and low fat dairy products has been shown to lower blood pressures (the "DASH" diet).

Drug therapy. Hypertension is a chronic disease. Thus, the choice of which medication(s) to prescribe has long term implications.

Drug selection. Data from a very large multicenter RCT supported by smaller studies demonstrate that moderate-to-high dose thiazide diuretics (chlorthalidone 25 mg/day) are as good as any other class of agents in reducing cardiovascular adverse outcomes, and superior in secondary outcomes such as stroke and CHF. Most patients will require two or more drugs to achieve control, and a few will not tolerate thiazides. The choice of additional or alternative medication should be individualized to achieve the target BP and the following goals:

- Once daily administration
- Reduction in CV complications demonstrated in clinical trials
- Choice of agent(s) that also treat concurrent conditions
- Least potential disruptive side-effects based on concurrent conditions or lifestyles
- Least expensive (both in pharmaceutical and laboratory monitoring costs)
- Fixed combination therapy can be more cost-effective and may improve compliance. Some patients may benefit from beginning with fixed combination therapy (eg, in Stage 2 hypertension or for patients resistant to monotherapy in the past).

All agents *within* a class have similar physiological action, except calcium channel blockers and beta blockers, which have sub-classes with different physiological effects. If monotherapy is not effective in reaching the BP goal, the addition or substitution of a different class with different physiological action is indicated. Combining medications from the same class is not effective. Table 2 shows costs of drug treatment for various antihypertensive agents.

Diuretics, beta blockers, ACE inhibitors, and long-acting dihydropyridine CCBs have been shown in randomized controlled trials to reduce cardiovascular morbidity and mortality. The ALLHAT study was a large multicenter direct comparison RCT designed to determine if the older or newer agents are more effective in prevention of cardiovascular morbidity and mortality. It compared treatment starting with a thiazide diuretic, an ACE inhibitor, a long-acting dihydropyridine CCB, and an alpha-blocker. Beta blockers and centrally-acting agents were used as the second step drugs; almost three-fourths of patients required two or more drugs. Beta blockers were the most commonly used second agent. The alpha blocker arm was discontinued early because of an excess of adverse outcomes. The other agents performed equally in primary outcome (coronary endpoints), but the thiazide (chlorthalidone), in moderate to high doses, was superior in secondary outcomes (stroke and CHF). This finding was consistent across age and race, and in all subgroups including patients with diabetes, coronary disease, and hyperlipidemia.

Existence of other risk factors, co-morbidities, and concern for untoward drug effects may influence initial drug selection. ACE inhibitors, ARB's, and CCBs may be initial options. Beta blockers are not preferred as initial therapy in the elderly unless compelling other conditions exist, eg, coronary artery disease (see Table 1). Recent meta-analyses suggest that beta blockers may be less effective in stroke reduction when compared to other classes of antihypertensive therapy. Beta blocker usage for HTN may be deferred unless CAD or CHF exists.

For African Americans without DM or CKD, a thiazide diuretic and/or CCB may be considered as first and second line antihypertensive medications. However, an ACEI or ARB may be more appropriate for African Americans with DM and/or CKD with estimated GFR of < 60 ml/min and also for those where a clinical suspicion of milder CKD exists, eg, positive for microalbuminuria. This recommendation differs from JNC 8, which recommends a thiazide diuretic or CCB as initial antihypertensive therapy for African Americans, including for those with diabetes.

No clear guidelines exist regarding whether specific drug combinations impart superior clinical outcomes (eg, ACEI/CCB vs. ACEI/diuretic. Large, well-designed trials (ACCOMPLISH with benazepril/amlodipine vs. benazepril/HCTZ, ACCELERATE with aliskiren and amlodipine vs. either alone) raise the possibility that a combination of a blocker of the renin-angiotensin system and calcium channel blocker may be superior to other combinations and single agents. Currently, the combinations of ACEI/ARB, ACEI/direct renin inhibitor (DRI), or ARB/DRI are not recommended in HTN management.

Diuretics. Thiazide diuretics have traditionally been the initial treatment for most patients with hypertension. Although the trials that showed a decrease in cardiovascular morbidity and mortality used moderate to high dose diuretics, higher dosages of thiazide diuretics have shown only minimal improvement in BP control. Consequently, the maximum suggested dosage of thiazide diuretics has been lowered in order to avoid metabolic side-effects. The range of hydrochlorothiazide is 12.5 mg to 50 mg each morning. In patients more vulnerable to side effects, such as the elderly, even this range should be approached with caution. The most studied thiazide is chlorthalidone, though hydrochlorothiazide is the predominant prescription thiazide in the USA.

Side effects. Thiazide diuretics increase the frequency of sexual dysfunction in men and women and initially may cause interruptions in daily routine for micturition. Thiazides cause a short-term increase in LDL cholesterol; however, long-term trials have shown minimal change and outcome studies show no clinical impact. Thiazides slightly increase the risk for diabetes (ALLHAT). While small changes in LDL and glycemic control are not contraindications, the clinical impact of these metabolic aberrations has yet to be elucidated. Thiazides can increase uric acid and precipitate attacks of gout. Hypokalemia is uncommon at usual (12.5-25 mg) doses but occurs relatively often at doses of 50 mg or more.

Loop diuretics. These diuretics are preferred for individuals with renal impairment (serum creatinine $\geq$ 2.5 mg/dl) and individuals allergic to thiazide diuretics. Loop diuretics are useful for reducing preload, which contributes to hypertension in renal-impaired individuals. Hypokalemia is less common due to the renal impairment, but should still be monitored. Loop diuretics are not as likely as thiazide diuretics to cause gout.

Angiotensin converting enzyme (ACE) inhibitors. As a class, ACE-inhibitors have similar actions and side effects, with the only major difference being duration of action. ACE inhibitors reduce BP with generally few side effects and slow the decline of renal function in most diseases. The renoprotective effect may be augmented when combined with angiotensin receptor blocker. Ramipril was shown in a randomized controlled trial to decrease cardiovascular events in hypertensive and normotensive individuals with systolic heart failure over placebo. However, newer trials have not shown renin-angiotensin blockade to be superior to other medications in decreasing morbidity and mortality. Onset of diabetes was not prevented by ramipril in a study directly addressing this issue.

Side effects. Angioedema is a rare side effect (0.1-0.7%), which may be life-threatening and may occur at any point in the treatment. The incidence may be higher in African Americans. Although renal artery stenosis per se is not a contraindication for ACE therapy, renal impairment may occur in patients with bilateral renal artery stenosis or unilateral renal artery stenosis with a single kidney. All in this class induce cough equally, which may be disabling enough with some patients to result in the need to discontinue the drug; cough occurs more often in women. **This class is contraindicated in pregnancy.**

Angiotensin II receptor antagonists (ARB) displace angiotensin II (AII) from its type 1 receptors. Losartan and irbesartan have been shown in randomized, double-blind trials in diabetics with microalbuminuria or azotemia to decrease the development of frank proteinuria or progression to renal failure requiring dialysis or transplantation. In patients who have systolic heart failure and are intolerant to an ACEI because of cough, ARBs are recommended.

Side effects. Angioedema has been rarely reported with Losartan, but has occurred in patients with prior angioedema on ACE inhibitors. Losartan has a uricosuric effect (i.e. increases excretion of uric acid, lowering concentration in blood) that is unique compared to others in this class. Losartan may be less efficacious compared to others in this group at lowering BP and should be used twice a day. **This class is contraindicated in pregnancy.**

Calcium channel blocking (CCB) agents. There are three classes of calcium channel blocking agents based on different calcium channel receptors, all with different physiological effects and side effects: verapamil, diltiazem, and dihydropyridines. All long acting dihydropyridine CCBs have been shown to reduce blood pressure and cardiovascular events.

Of the dihydropyridine CCBs, the longer-acting agents (eg amlodipine, felodipine, nisoldipine) make single daily dosing possible. These drugs provide the most reliable and significant blood pressure reduction in most patient subtypes. They are particularly effective in stroke reduction and have been shown to reduce overall CVD risk. The short-acting agents are not indicated for hypertension.

Some effects with specific diseases include:

- *Acute coronary syndrome.* Short-acting dihydropyridines should be avoided in the first 24-48 hours of an acute coronary syndrome.
- *Chronic kidney disease.* Dihydropyridines should be avoided as a single agent for patients with microalbuminuria or proteinuria, as they will worsen protein loss and renal function, but may be used in combination with ARB or ACE inhibitors.
- *Chronic CAD.* Verapamil has shown to be as effective as a beta-blocker in patients with CAD or remote history of MI. The long-acting dihydropyridine agents may be used in patients with angina; however, some feel that they only should be used when combined with a beta blocker. All CCBs can be used in hypertensive patients with chronic CAD to reduce anginal episodes.
- Aortic regurgitation. Nifedipine may be useful in hypertensive patients with aortic regurgitation.

Side effects. Edema may occur and is more pronounced with the dihydropyridine agents.

Bradycardia is a side effect of verapamil and diltiazem, but renders them useful agents in the treatment of atrial fibrillation/SVT). Verapamil has more pronounced bradycardia effects and often results in constipation. Verapamil and diltiazem may increase risk for statin myopathy (cytochrome 3A4 inhibition).

Aldosterone inhibitors. Spironolactone and eplerenone are used in certain conditions associated with hypertension, such as resistant hypertension, hyperaldosteronism, and potassium wasting. However, when used in patients with chronic kidney disease, or concurrently with potassium sparing agents (ACEI, ARB, triamterene), they carry significant risk for **life-threatening hyperkalemia.** Combination therapy is generally restricted to patients with systolic heart failure, and requires close follow-up. Gynecomastia and breast pain are common side effects with spironolactone, causing discontinuation in about 10%.

Beta blockers have been shown to reduce cardiovascular morbidity and mortality in controlled clinical trials for both diastolic and isolated systolic hypertension. However, one study showed that diuretics are superior to beta-blockers for stroke reduction, and another showed that losartan is superior to beta blocker for CVD reduction. The results of three meta analyses suggest that other antihypertensive agents are superior to most beta-blockers for initial therapy. In addition, atenolol has poorer outcomes when compared to other beta-blockers (an excess stroke risk of 17%).

Beta blockers are indicated for patients with coronary disease or CHF unless specific contraindications or documented intolerance exists. Certain beta blockers (eg, carvedilol) also have alpha blocking properties and are useful for maintenance therapy of heart failure. Discussion regarding other properties of beta blockers, such as B1 selectivity and lipid solubility, are beyond the scope of this guideline.

While a target heart rate of < 60/minute has been suggested in using beta blockers for patients with systolic heart failure, no target has been established for patients with uncomplicated hypertension.

Side effects. Occasionally fatigue and uncommonly impotence are side effects at the recommended low doses. Beta-1 blockers produce the same dramatic reduction in angiotensin II levels as ACE inhibitors, and the two agents together have an additive effect. Though beta blockers may raise triglycerides and lower HDL cholesterol, these effects have not been found to be clinically significant in outcome studies.

Renin inhibitors are a novel way of blocking the renin-angiotensin-aldosterone system (RAAS). The first drug in this class is aliskiren. The drug has been shown to lower blood pressure alone or in combination with other antihypertensives, but its effects on clinical outcomes is unknown. Aliskiren should be used as a fourth line agent in patients who have failed standard therapy.

Side Effects. As with other RAAS agents, aliskiren can cause an increase in serum creatinine and potassium especially is used in combination with an ACE inhibitor or ARB. **This class is contraindicated in pregnancy.**

Peripheral alpha blockers. **Alpha blockers should not be used as initial therapy for hypertension but may be added to a thiazide or other outcome-improving agent for additional BP control, or when treatment for lower urinary tract symptoms due to prostatic hyperplasia is desired.**

Side effects: Alpha blockers may cause first dose syncope, so are generally started at bedtime and slowly titrated up in dose. They may cause fluid retention and edema. The ALLHAT study showed a 25% increase in cardiac events in the doxazosin vs. chlorthalidone group.

Centrally-acting alpha-2 agonists are less often used due to their side-effects. They have no evidence of outcome benefit. Methyldopa remains a first line agent in pregnancy.

Side effects. May induce bradycardia; dry mouth and sedation are common. Rebound hypertension may occur with sudden discontinuation of clonidine.

Direct vasodilators. These drugs are fourth line agents for essential hypertension and should be used in patients who have failed standard therapy. Direct vasodilators induce reflex tachycardia and thus should be combined with a beta blocker or non-dihydropyridine calcium channel blocker. Due to increased fluid retention, they should also be combined with a diuretic. These agents have not been shown to reduce left ventricular hypertrophy. They are third- or fourth-line agents, sometimes useful in refractory hypertension.

Hydralazine may produce a lupus erythematosus-like syndrome; the syndrome is extremely rare when the daily dose is less than 200 mg. Side effects include headache, palpitations, anorexia, and nausea. At least twice daily dosing requirements limit the usefulness of this drug. Hydralazine has shown benefit in CHF when combined with a nitrate.

Minoxidil is effective in treating the severest forms of hypertension, although it is used less frequently today because ACE inhibitors and calcium channel blockers may be as effective. Side effects include hypertrichosis and fluid accumulation in serous cavities, including the pericardium.

Monitoring Blood Pressure Control

No studies demonstrate the most appropriate monitoring of BP and follow-up. The following is a consensus opinion of

the guideline team.

Blood pressure measurement. All patients who have been diagnosed with hypertension should be taught the technique of home BP monitoring, assuming that there are no cognitive deficiencies that would preclude the technique. A handout about the purchase and proper technique may be used. Patients should purchase an electronic, digital home BP cuff. The proper cuff size should be indicated to the patient by the healthcare provider. Automatic (self-inflating) and non-automatic electronic monitors are equally effective, with the non-automatic being cheaper but more labor intensive.

Patients should be instructed to take their BP daily, upon awakening and before dinner (other times as necessary), until the BP is controlled to the targeted range discussed above. After BP control is achieved, BP may be obtained monthly. The BP readings should be recorded on a BP monitoring sheet and sent or brought to the physician. The wrist and finger units, although easy to use, are not reliable for monitoring blood pressure.

Prehypertension. Follow at least annually.

Stage 1 hypertension. Once antihypertensive therapy is initiated, most patients should return for follow-up and adjustment of medications at monthly intervals or less until the BP goal is reached. The effect of an antihypertensive agent on BP is typically stabilized in < 2 weeks. At each visit, BP control, adverse medication effects, patient adherence, and new target organ damage should be assessed. If after 1-3 months the BP does not reach the targeted goal:

1) Ensure that the patient is believed to be taking the medication as prescribed.
2) Ensure that the dose of the medication is adequate.
3) Reconsider reversible causes.
4) Add a second drug from another class if necessary to reach goal.

After BP is at goal and stable, follow-up visits can usually be at 3- to 6-month intervals. A randomized controlled trial showed that for stable patients that patient outcomes were equivalent for follow-up intervals of 3 and 6 months. No evidence currently exists regarding the equivalence of 6-month and 12-month intervals. Serum potassium and creatinine should be monitored at least annually. Monitoring for microalbuminuria may also be useful.

Stage 2 hypertension. Follow-up is generally similar to that for medical therapy for Stage 1 hypertension, except more frequent visits may be necessary, eg, more frequently than monthly intervals initially to adequately control BP.

Additional considerations. Most patients will require two or more medications to reach goal. Fixed dosage combination antihypertensive medications may simplify therapy and improve adherence, but generic individual agents are usually less costly.

If blood pressure is uncontrolled after persistent attempts to do so, or multiple (> 3) drugs are needed, consider referral to a hypertension specialist.

Intolerance to multiple medications may be an indication of over-treated hypertension due to a significant white coat effect. Ambulatory or home BP monitoring may then be helpful.

Controlled BP. Once BP is controlled, office visits every 3-6 months are appropriate. At any time, for any stage of hypertension, consultation with a clinician skilled in the management of hypertension should be considered if BP cannot be controlled adequately, patient compliance is poor, or there is difficulty identifying exacerbating conditions or medications.

Resistant hypertension. Resistant hypertension is the failure to reach goal BP in patients who are adhering to full doses of an appropriate 3-drug regimen that includes a diuretic. After excluding potential identifiable causes of hypertension (Table 5), clinicians should explore reasons why the patient is not at the goal BP. Particular attention should be paid to diuretic type and dose in relationship to renal function because thiazide-type diuretics lose effect once the GFR falls < 30 ml/min. Consultation with a hypertension specialist should be considered if goal BP cannot be achieved.

Special Considerations

Hypertension and Pregnancy. The use of antihypertensives in pregnancy must consider fetal well-being. Treating uncomplicated Stage 1 hypertension is often not necessary in otherwise low-risk women with normal renal function and no other target organ disease. These women should be closely followed during pregnancy. Pre-eclampsia or other pregnancy-induced hypertension should be treated by a physician experienced in managing these diseases.

Women considering pregnancy, who are hypertensive and require treatment, should be on antihypertensive medication ideally three to six months prior to conception. Medications for treating significant hypertension during pregnancy, in order of preference, are:

1) Methyldopa – the drug with the longest experience Problems with this medication include frequent side effects and the need to dose multiple times a day.
2) Beta-blocker with or without diuretic (avoiding atenolol, which may be associated with intrauterine growth retardation) – are relatively popular and the first choice of some.
3) Labetalol
4) Calcium channel blockers

Diuretics are also acceptable to use.

Contraindicated in pregnancy are ACE inhibitors, ARBs, and

renin inhibitors.

Ongoing diabetes screening. While screening for diabetes is recommended when a mean BP > 135/80 is first identified, for patients with hypertension an optimal interval for subsequent screening for diabetes is not known. The American Diabetes Association (based on expert opinion) recommends screening at 3-year intervals.

Elderly patients. The benefit of treating hypertension in older adults has been well established. The HYVET study confirmed substantial reduction in cardiovascular risk and mortality from treating hypertension in patients age 80 and older, to a target of 150/80 mm Hg.

No clear benefit has been shown for SBP targets lower than < 150 (eg, < 140). Lowering DBP to < 65 is a theoretical risk. No clear evidence exists to determine the relative risk of achieving a SBP < 150 if that treatment also lowers DBP to <65.

Orthostasis is a common problem in the elderly and monitoring standing and supine BP is important during treatment to identify this.

Antihypertensive choice in the elderly is similar to other age groups. Beta blockade should be avoided unless there is a compelling indication such as CAD or CHF. Lower initial antihypertensive drug doses and slower titration is generally recommended.

Related National Guidelines

This guideline is consistent with JNC 7, updated with results of major trials subsequently (see references). It is consistent with the report from the panel members appointed to JNC 8, except for African Americans without evidence diabetes or CKD, this guideline recommends the same initial drugs as for other patients without evidence of diabetes or CKD.

Strategy for Literature Search

Preliminary evidence was identified using literature considered relevant in JNC 7 (see annotated references). That report utilized literature searches of the preceding reports and added a systematic search of literature from January 1997 through April 2003.

In 2007 a search of literature from 2003–2007 was performed that was also utilized to develop the 2009 version of this guideline. That search was conducted on Medline prospectively using the major keywords of: *hypertension*, *human adults*, *English language*, *clinical trials*, *guidelines*, and *published from 1/1/03 through 5/1/07*. Terms used for specific topic searches within the major key words included: *alpha 1 blocker*, *angiotensin converting enzyme inhibitors*, *angiotensin II receptor antagonist, beta blockers (selective and non-selective), calcium channel blockers (dihydropyridine and non-* d*ihydropyridine forms), centrally acting alpha-2 agonist, diuretics (thiazide and non-thiazide, loop, potassium-sparing), vasodilator (direct), avoidance (alcohol, stress, tobacco), blood pressure monitoring (ambulatory, home), dietary (caffeine, calcium, garlic, magnesium, onion, potassium, sodium), exercise, disease-based management (stroke, coronary artery disease, cardiac, heart failure, arterial fibrillation, peripheral vascular disease, diabetes, chronic kidney disease, metabolic syndrome), and resistant hypertension.*. Detailed search terms and strategy available upon request.

In 2013 the full literature search was deferred while waiting for the search results of JNC 2013 ("JNC 8"). However, expert member of the team identified three topics for which important new evidence had been published and systematic searches were performed on those topics. The search was conducted on Medline prospectively using the major keywords of: *hypertension, human adults, English language, guidelines, clinical trials, cohort studies*, and *published from 1/1/03 through 6/1/13*. Terms used for specific topic searches within the major key words included: *combination of 'ACE (angiotensin converting enzyme) inhibitors and ARB (angiotensin receptor blockers), combination of ARB and DRI (direct renin inhibitors), and patients age ≥ 65 years (older/elderly) and target blood pressure and treatment.*

The search was conducted in components each keyed to a specific causal link in a formal problem structure (available upon request). The search was supplemented with very recent information available to expert members of the panel, including abstracts from recent meetings and results of clinical trials. Negative trials were specifically sought. The search was a single cycle. Conclusions were based on prospective randomized clinical trials if available, to the exclusion of other data; if randomized controlled trials were not available, observational studies were admitted to consideration. If no such data were available for a given link in the problem formulation, expert opinion was used to estimate effect size.

Measures of Clinical Performance

National programs with related clinical performance measures include the following:

- Centers for Medicare & Medicaid Services (CMS)

Regional programs that have clinical performance measures of prenatal care include the following.

- Blue Cross Blue Shield of Michigan (BCBSM)
- Blue Care Network [HMO]: clinical performance measures (BCN)

These program's clinical performance measures for hypertension are summarized below. When programs have measures, the measures are generally similar, although

specific details vary (eg, population inclusions and exclusions).

Controlling high blood pressure. The percentage of patients aged 18–85 years with a diagnosis of hypertension and whose blood pressure was adequately controlled (< 140/90) (Medicare, BCBSM, BCN).

Hypertension improvement. Improvement in blood pressure. The percentage of patients aged 18-85 years with a diagnosis of hypertension whose blood pressure improved during the measurement period (Medicare).

Preventive care and screening for hypertension. Screening for high blood pressure and follow-up documented. Percentage of patients aged 18 years and older seen during the reporting period who were screened for high blood pressure AND a recommended follow-up plan is documented based on the current blood pressure reading (Medicare).

Additional measures regarding care for hypertension exist for patients with specific medical conditions, eg, diabetes, coronary artery disease.

Disclosures

University of Michigan Health System endorses the Guidelines of the Association of American Medical Colleges and the Standards of the Accreditation Council for Continuing Medical Education that the individuals who present educational activities disclose significant relationships with commercial companies whose products or services are discussed. Disclosure of a relationship is not intended to suggest bias in the information presented, but is made to provide readers with information that might be of potential importance to their evaluation of the information.

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Review and Endorsement

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APPENDIX. Standardized Blood Pressure Measurement

Types of Measuring Devices

- **Aneroid manometer** could be used. However, the deflated cuff should read exactly zero, and it should be calibrated at least yearly, unless used frequently and then yearly.
- **Electronic manometers** should be calibrated twice a year if used weekly, or once a year if used less often.
- **The cuff** should be the appropriate size for the measured arm, and each cuff should have markers to note the proper selection.

Proper Technique

1. **Prior activity.** Ideally, the patient should not have:
   - within 30 minutes – smoked, ingested caffeine, or exercised
   - within 2 hours – eaten or ingested alcohol
2. **Preparation.** The patient should sit with their back supported and feet on the floor (not seated on the exam table) for 5 minutes before the 1st blood pressure is taken.
3. **First visit: bilateral measures.** The blood pressure should be measured at least once in each arm (at the patient's first visit) to assure that there is no difference in blood flow (i.e., should be < 10 mm Hg difference), and if there is a significant difference, the higher pressure should be used thereafter.
4. **Cuff. Improper cuff size is the most common source of measurement error.** The arm should be bare, and the cuff should be fitted securely so that the bladder midline is over the brachial artery and the lower edge of the cuff is 1 inch above the antecubital fossa.
5. **Gauge.** The gauge should be at eye level.
6. **Arm.** The patient's arm should be supported, and the stethoscope or measurement point should be at heart level.
7. **Inflation.** Inflate the cuff at least 30 mm Hg above the systolic reading and deflate at a maximum of 2-3 mm per second or a maximum of 2 mm per pulse beat between the Korotkoff sounds.
8. **Measurement.** Record the systolic reading at the first sound heard Korotkoff phase I and the diastolic reading as the last sound heard Korotkoff phase V. If there is a muffling of the sound, this should also be recorded Korotkoff phase IV (eg - 150/50/0).
9. **Repeated measurement.** Take the patient's pulse while waiting to repeat a second measurement after 1-2 minutes. If the measurement is performed immediately after walking into the room and the reading is normal, it should be recorded and repeated in 1-2 minutes. If the blood pressure is elevated immediately after walking into the room, it should not be recorded and the blood pressure should be repeated after 5 minutes of rest. At least two readings should be taken, and if the readings vary by more than 5 mm Hg diastolic, the readings should be repeated until there is less variability.
10. **Other recorded information.** The arm used, position of the patient, and the size of the cuff (when non-standard cuff size used) should be recorded.
11. **Inform.** Inform the patient of the readings.