MANAGEMENT OF HYPERTENSION

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Algorithm for Treatment of Hypertension

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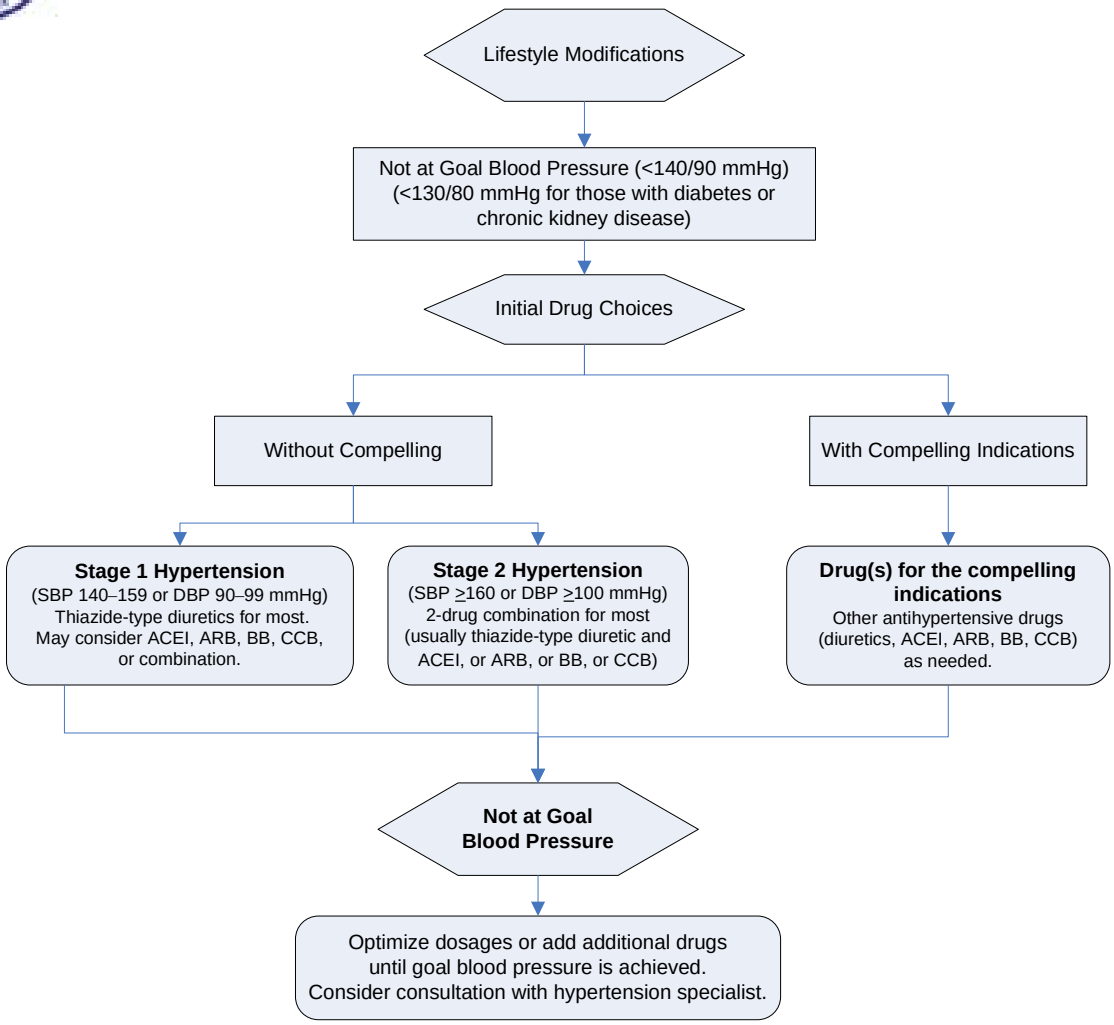

Table 1. Classification of Hypertension and Recommended Follow-up (based upon JNC-VII)

Category	Systolic	Diastolic	Follow-up *
Normal	<120	<80	Every 2 years
Pre-Hypertension	120-139 or	80-89	Within 1 year
Hypertension			
Stage 1	140-159 or	90-99	Confirm in 2 months*
Stage 2	≥160 or	≥100	Evaluate in 1 week*

* Modify according to risk factors and target organ damage

Table 2. Lifestyle Modifications

- Encourage weight loss/maintenance
- Modify dietary sodium: Current recommendation is less than 2.3 g /day (**Sodium content of foods**)
- Modify alcohol intake: No more than 1 oz of ethanol (eg, 24 oz [720 ml] of beer, 10 oz [300 ml] of wine, or 2 oz [60ml] of 100 proof whiskey) per day, less for women and light-weight people
- Increase physical activity: (30 – 45 minutes of aerobic activity 5x/week). Brisk walking is inexpensive and effective. Resistive isotonic activities are not recommended to lower BP in hypertensive patients if that is the only form of activity (h/o: yoga, tai chi/qi gong)
- Educate on stress management techniques (relaxed breathing, meditation)
- Home Blood Pressure Monitoring (calibrate with Family Medicine Clinic).
- Tobacco avoidance: All smokers should be advised to stop and offered assistance in cessation – refer to Tobacco Dependence Treatment Program if ready to quit within 30 days.
- Potassium: High dietary potassium may protect against hypertension development and hypokalemia may exacerbate hypertension and induce ventricular arrhythmia (**Potassium-containing foods**). Intake recommendations: .5-10 g/day from food sources, or at least 2.4g/day of supplemental K+.
- Reduce intake of saturated fat and cholesterol for overall cardiovascular health (**healthy/unhealthy fats, cholesterol, transfats**)
- Maintain adequate intake of dietary calcium and magnesium for general health (Magnesium-Containing Foods, **Calcium-containing foods**). Calcium AI (adequate intake): Men 1000mg/day, Women 1200mg/day (and those over 50 years of age). Magnesium AI (adequate intake): 350-700mg/day.
- **DASH Diet** – high fiber & fruit/vegetable diet proven helpful in reducing blood pressure
- Fiber: recommend 25g/day – (**fiber sources**)
- Recommend a Multivitamin, especially if not eating 5 servings of fruits/vegetables/day or whole grains.
- Consider HED referral for further consult on Lifestyle Management of Hypertension.

**Fiber, DASH Diet, Multivitamins may affect drug therapy – monitor accordingly.

Table 3. Lifestyle Modifications to Manage Hypertension* from JNC-VII guideline

Modification	Recommendations	Approximate Systolic BP Reduction Range
Weight reduction	Maintain normal body weight (BMI 18.5-24.9)	5-20 mm Hg/10-kg weight loss
Adopt DASH eating plan	Consume a diet rich in fruits, vegetables, and low-fat dairy products with a reduced content of saturated and total fat	8-14 mm Hg
Dietary sodium reduction	Reduce dietary sodium intake to no more than 100 mEq/L (2.4 g sodium or 6 g sodium chloride)	2-8 mm Hg
Physical activity	Engage in regular aerobic physical activity such as brisk walking (at least 30 minutes per day, most days of the week)	4-9 mm Hg
Moderation of alcohol consumption	Limit consumption to no more then 2 drinks per day (1 oz. or 30 mL ethanol [eg. 24 oz. beer, 10 oz wine, or 3 oz 80-proof whiskey]) in most men and no more then 1 drink per day in women and lighter weight persons	2-4 mm Hg

Abbreviations: BMI, body mass index calculated as weight in kilograms divided by the square of height in meters, BP, blood pressure; DASH, Dietary Approaches to Stop Hypertension.
* For overall cardiovascular risk reduction, stop smoking. The effects of implementing these modifications are dose and time dependent and could be higher for some individuals.

Table 4. Reversible Causes of Sustained Elevated Blood Pressure Readings

Medications:	Medications:	Illicit/Other drugs:*	Diet:
NSAID's	appetite suppressants	cocaine	High sodium (esp elderly, or African-American)
oral contraceptives	anti-depressants	amphetamines	(Low Potassium)
mineralocorticoid/ glucocorticoid steroid	MAO inhibitors	anabolic steroids	Other Conditions:
nasal decongestants	cyclosporine	tobacco	Sleep apnea
oral decongestants	erythropoietin	caffeine	
		alcohol	

*=If patient presents with HTN due to substance abuse, referral to Behavioral Health Consultant.

Table 5. Targeted History and Physical

History:

- Previous elevated BP
- History or symptoms of CHD, heart failure, cerebrovascular disease, peripheral vascular disease, renal disease, diabetes mellitus, dyslipidemia, other co-morbid conditions, gout or sexual dysfunction
- Family history of hypertension, myocardial infarction, or CVA
- Dietary intake of sodium, saturated fat, and caffeine
- Smoking, drug, and alcohol use
- Physical activity level
- Medications: e.g. oral contraceptives, herbal remedies
- Psychosocial and environmental factors (e.g. family situation, employment status, education level)
- **Screen for secondary hypertension**
  History: renal, endocrine, thyroid disease
  Symptoms: sweating, palpitations, headache, hematuria, flank pain

Physical exam:

- Two or more blood pressure measurements separated by 2 minutes with patient either supine or seated and after standing for 2 minutes.
- Height and weight. Assess BMI
- Funduscopic exam for arteriolar narrowing, hemorrhages, exudates, papilledema
- Neck: Carotid bruits, distended veins, enlarged thyroid
- Heart: Abnormal rate and rhythm, increased size, precordial heave, clicks, murmurs and third and fourth heart sounds

Table 5. (Physical exam cont)

- Lungs: Rales, evidence of bronchospasm
- Abdomen: Bruits, enlarged kidneys, masses, and abnormal aortic pulsation
- Extremities: Diminished peripheral arterial pulsations, bruits, and edema
- Neurological assessment

Labs:

Fasting blood sugar, total cholesterol and HDL, CBC, urinalysis, potassium, sodium, creatinine.
EKG, Chest X-ray if concerned about CHF

Patient at risk for secondary HTN: TSH, albumin, calcium, others as determined by history and physical

Table 6. Components of Cardiovascular Risk Stratification in Patients with Hypertension

Major Risk Factors:

- Smoking
- Dyslipidemia
- Diabetes mellitus
- Age > 60 yrs
- Men and postmenopausal women
- Family history of CAD in women <65 or men < 55

Diagnosis of End Organ Damage:

- Cardiac: Left Ventricular Hypertrophy
  Angina/prior MI
  Prior coronary revascularization
  Heart failure
- Brain: Stroke or TIA
- Kidney: Nephropathy, [proteinuria (>1+), elevated creatinine (>1.5 mg/dl)]
- Peripheral Vasculature: Claudication, aneurysm
- Eye: Retinopathy: hemorrhages, exudates, papilledema

Table 7. Risk Stratification and Treatment

Blood Pressure Stages	Risk Group A No Risk Factors No Target Organ Disease	Risk Group B At least 1 Risk Factor (not including Diabetes) No Target Organ Disease	Risk Group C Target Organ Disease and/or Diabetes With or without Risk Factors
Pre-Hypertension (120-139/80-89)	Intensive Lifestyle Modification	Lifestyle Modification Consider Drug Therapy	Drug Therapy and Lifestyle Modification
Stage 1 (140-159/90-99)	Lifestyle Modification (up to 3 months) Consider Drug Therapy	Lifestyle Modification Consider Drug Therapy	Drug Therapy and Lifestyle Modification
Stage 2 (>160/>100)	Drug Therapy and Lifestyle Modification	Drug Therapy and Lifestyle Modification	Drug Therapy and Lifestyle Modification

Table 8. Selected Antihypertensive Drugs available at ANMC. Begin with the lowest dose of appropriate medication and allow an adequate trial (1-2 months) before increasing dose or adding second medication

Drug (Generic)	**Strength**	**Usual Dosage Range** (total mg/day)	**Special Considerations**
Diuretics			
Hydrochlorothiazide (HCTZ)	25,50 mg	12.5 – 25 mg Q day	Provide dietary counseling to avoid metabolic changes (e.g. low salt diet, K+). At low doses (12.3-25mg/day) potassium supplements not usually required. Can cause clinical gout.
HCTZ/Triamterene	H=25mg T=37.5mg	1 tablet Q day	Use with caution in patients susceptible to hyperkalemia (e.g. avoid use with ACE inhibitors)
Furosemide	20, 40mg	40-160 mg Q day or ÷ BID	Better BP effect when dosed BID
Bumetanide	1, 2mg	0.5-2mg Q day	1mg equivalent to 40mg furosemide
Torsemide	20mg	5-20mg Q day	
Spironolactone	25mg	50-100mg Q day or ÷ BID	Avoid in hyperkalemia, renal failure
Beta Blockers			↓ dose in renal failure
Atenolol	25, 50, 100 mg	25-100mg Q day	
Propranolol	10, 20, 40, 60, 80 mg	40 –240 mg ÷ BID	
Metoprolol	50, 100 mg	100 – 300 mg ÷ BID	
Nadolol	20, 40mg	40-320mg once/day	
ACE Inhibitors			
Lisinopril	2.5, 5, 10, 20, 40 mg	5 – 40mg Q day or ÷ BID	↓ dose in renal impairment: ↓ dose or d/c diuretic if possible; initiate therapy with lower doses and monitor closely
Calcium Channel Blockers			
<u>Nondihydropyridine</u>			
Verapamil SR	120, 180, 240 mg	120 – 480 mg Q day or ÷ BID	May ↓ sinus rate and produce heart block. Verapamil has most negative ionotropic effect
Diltiazem SR	120, 180, 240, 300, 360 mg	180 – 360 mg Q day or ÷ BID	
<u>Dihydropyridine</u>			
Nifedipine XL	30, 60 mg	30 – 60 mg Q day	
Alpha -1 Receptor Blocker			
Prazosin	1, 2, 5 mg	1-20 mg ÷ BID or TID	Postural effects; measure standing BP
Doxazosin	2, 4, 8 mg	1-16mg qhs	
Alpha-2 Agonists			
Clonidine	0.1 mg tab 0.1, 0.2, 0.3 mg patch	0.1 – 1.2 mg ÷ BID or TID 1 patch/week	Avoid abrupt discontinuation
Methyldopa	250 mg	500 – 3000 mg ÷ BID or up to QID	May rarely cause hemolytic anemia and liver disorders; male sexual dysfunction
Direct Vasodilators			
Hydralazine	10, 25, 50 mg	10 mg TID –100 mg BID	Avoid in patients with CHD
Peripheral Adrenergic Antagonist			Dose related depression rare at dosages less than 0.25mg/day.
Reserpine	0.25mg	0.05 – 0.5 mg Q day or ÷ BID	Male sexual dysfunction
Angiotensin II receptor blocker			Elevated liver enzymes and liver disease. Caution use with other potentially hepatotoxic drugs
Telmisartan	40, 80 mg	20 – 80 mg Q day	

Table 9. Choice of Pharmacotherapy in Special Patients *in addition to Lifestyle Modification (Table 2)

Patient Characteristics	Drugs of Choice	Alternatives	Relative Contraindications
Uncomplicated	Low dose hydrochlorothiazide[1] Beta blockers	Verapamil[2], prazosin, clonidine, lisinopril,	
African American	Low dose hydrochlorothiazide[1] Nifedipine	Beta blockers (add to HCTZ), Verapamil[2], prazosin, clonidine	Lisinopril
Asthma/COPD	Low dose hydrochlorothiazide[1]	Verapamil[2], prazosin, clonidine, lisinopril	Beta blockers
Benign Prostatic Hypertrophy	Prazosin, Doxazosin		
Congestive Heart Failure with Systolic Dysfunction	Lisinopril, Low dose hydrochlorothiazide[1], ARB	Nitrates plus hydralazine, carvedilol[3], felodipine, spironolactone	Other beta blockers, other calcium blockers
CHF with Diastolic Dysfunction or Hypertrophic Cardiomyopathy	Beta blockers, verapamil,	Lisinopril, ARB	Direct vasodilators
Coronary Artery Disease	Beta blockers, diuretics	Verapamil[2], diltiazem, lisinopril	Direct vasodilators, short-acting calcium blockers
Peripheral Vascular Disease	Low dose hydrochlorothiazide[1] Nifedipine (sustained release)		
Post Myocardial Infarction	Beta blockers (non ISA), lisinopril	Spironolactone, ARB	Nifedipine
Diabetes	Low dose hydrochlorothiazide[1] Low dose Beta blockers (monitor lipids and glycemic control), lisinopril, ARB	Verapamil[2], prazosin, lisinopril	High dose diuretics
Diabetes with microalbuminuria or clinical grade proteinuria	Lisinopril, ARB	Low dose hydrochlorothiazide[1] ,Low dose Beta blockers, prazosin, verapamil, ARB	High dose diuretics, dihydropyridine calcium blockers
Hyperlipidemia	Low dose hydrochlorothiazide[1] Beta blockers	Verapamil[2], prazosin, clonidine, lisinopril	
Isolated Systolic Hypertension (elderly[6])	Low dose hydrochlorothiazide[5]	Beta blockers (add to HCTZ), nifedipine SR, hydralazine, lisinopril, verapamil	
Pregnancy (gestational HTN)[7]	Methyldopa, hydralazine, calcium channel blockers, labetolol	Beta blockers (late pregnancy)	Absolute contraindication: ACE Inhibitors, angiotensin II receptor blockers
Renal Impairment	Furosemide, clonidine, verapamil, ACEI, ARB	Beta blockers, prazosin, lisinopril[8]	Potassium sparing agents
Vascular Headache	Beta blockers	Verapamil (nondihydropyridine)	

[1]Low dose hydrochlorothiazide = 12.5-25 mg (potassium supplements are not usually necessary at these doses; [2]Verapamil added to beta-blocker therapy can be hazardous and should not be combined; [3]Use with caution; get input from cardiology; [4]Non ISA beta blockers include metoprolol, atenolol and propranolol; [5]TOMHS The Treatment of Mild Hypertension Study (JAMA Aug 11, 1993, No. 6) reports no statistically significant difference in lipid levels among five different drug treatment groups; [6]Administer drugs cautiously; use lower initial doses, more gradual dosage adjustments; [7]In chronic hypertension, continue current medications except ACE inhibitors or angiotensin II receptor blockers; [8]Monitor creatinine and potassium carefully in first few weeks of therapy. Use with caution in severe renal failure (Cr >2.5)

Table 10. Integrative Pharmacotherapy (Herbs or Nutraceuticals to consider as **adjunct** to Pharmacotherapy)

Nutraceutical	Strength	Usual Dosage Range (total mg/day)	Special Considerations
Fish Oil		4-8g Q day	Affects blood clotting, caution with anti-coagulant therapy
Co-enzyme Q10		50-200mg Q day	Caution with anti-coagulant therapy (may affect clotting time)
Magnesium		600-800mg Q day	May deplete Ca+, Phosphorus
Calcium	w/Vit. D	1000-1200mg Q day	

Fish Oil - There is evidence from multiple large-scale population (epidemiologic) studies and randomized controlled trials that intake of recommended amounts of DHA and EPA in the form of dietary fish or fish oil supplements lowers triglycerides, reduces the risk of death, heart attack, dangerous abnormal heart rhythms, and strokes in people with known cardiovascular disease, slows the buildup of atherosclerotic plaques ("hardening of the arteries"), and lowers blood pressure slightly. However, high doses may have harmful effects, such as an increased risk of bleeding. Although similar benefits are proposed for alpha-linolenic acid, scientific evidence is less compelling, and beneficial effects may be less pronounced.
**=Fish Oil may contain heavy metals – make sure it is a product tested for contaminants (i.e. Nordic Naturals, Carlsons, Walmart Brands).

CoQ10 - Preliminary research suggests that CoQ10 causes small decreases in blood pressure (systolic and possibly diastolic). Low blood levels of CoQ10 have been found in people with hypertension, although it is not clear if CoQ10 "deficiency" is a cause of high blood pressure. It is not known what dose is safe or effective. CoQ10 is less commonly used to treat hypertension than it is for other heart conditions such as congestive heart failure. Well-designed long-term research is needed to strengthen this recommendation.

Diets *low* in Magnesium and Calcium along with Potassium, have been shown to cause hypertension. Supplementation, or ideally eating foods rich in these minerals (such as in the DASH diet), might be helpful in treating the underlying nutritional deficiencies associated with hypertension.

Table 11. Drug-Induced Nutrient Depletion Considerations
(When patients are on long-term Pharmacotherapy)

Drug (Generic)	**Considerations**
Diuretics Hydrochlorothiazide (HCTZ)	Fluid intake suggestions (may deplete K+, Mg+, Na+, Zn, Phosphorous, CoQ10)
HCTZ/Triamterene	(may deplete Mg+, Na+, Ca+, Zn, CoQ10, Folic Acid, Vitamin B6)
Furosemide	(may deplete Mg+, Na+, K+,Ca+, Zn, Vitamins B1,B6,C)
Bumetanide	(may deplete Mg+, Na+, K+,Ca+, Zn, Vitamins B1,B6,C)
Torsemide	(may deplete Mg+, Na+, K+,Ca+, Zn, Vitamins B1,B6,C)
Spironolactone	
Beta Blockers Atenolol Propranolol Metoprolol Nadolol	(Beta blockers may deplete Co-enzyme Q10)
ACE Inhibitors Lisinopril	(ACE-inhibitors may deplete Zinc)
Alpha-2 Agonists Clonidine	(May deplete Co-enzyme Q10)
Methyldopa	
Direct Vasodilators Hydralazine	(May deplete Mg+, K+, B6, Zn, CoQ10)

Ref: 1) JNC VI Report 1997; JNC VII Report 2004
2) Clinical Practice Guideline for Screening, Evaluation and Management of Adult Hypertension. Kaiser Permanente
3) Drug-Induced Nutrient Depletion Handbook, 2001
4) Natural Standard Database, www.naturalstandard.com (peer-reviewed Integrative Medical resource)