

Under Pressure



Disclosures

- Relationship with Novartis Pharmaceuticals Corporation, Amgen, Amarin, Bayer, Pfizer, Lexicon Pharmaceuticals, and Idorsia that includes consulting or advising.
- Relationship with Janssen that includes research grant funding paid directly to the research department

Objectives

Hypertension is a disease with major implications for our patients' short- and long-term health journey.

We will:

- Review updated guidelines and the importance of early diagnosis and intensive treatment of Hypertension
- Discuss diagnosis and chronic management through lifestyle and pharmacologic treatment

Case 1

45-year-old female presents to establish care. She reports feeling well.

PMHx: Hypothyroidism. OB/GYN: No pre-eclampsia. Last menses 3 weeks ago.

FMHx: Mother had MI at age 65, 2 stents. Father is A&W.

SocHx: Bank manager. Married with 2 children. **Current smoker** and drinks 1-3 glasses of wine a week with dinner. Does not follow any specific physical activity regimen.

MEDS: levothyroxine 88 mcg qd, MVI

Vitals: BP **135/85**, HR 80, SaO2 96%, T 98.9, Wt 165 Ht 5'5" BMI 27.5

LABS: **TC 220**, Trig 200, **HDL 50**, LDL 145. A1c 5.6%, Fasting Glucose 99 mg/dL

- What is her ASCVD risk score? Do you agree? What are your recommendations?



Case 2

63-year-old female presents for annual follow-up. She reports feeling well.

PMHx: Occasional headaches OB/GYN: Post-menopausal since early 50's.

FMHx: Sister suffered MI at age 65, 3vCABG. Parents have passed. 2 brothers, 1 with DMII.

SocHx: Medical Technologist, working part-time. Married with 2 adult children.
Current smoker, no EtOH. Does not follow any specific physical activity regimen.

MEDS: Ibuprofen 400 mg PRN for headaches, MVI.

Vitals: BP **135/85**, HR 80, SaO2 96%, T 98.9, Wt 155 Ht 5'5" BMI 25.8

LABS: **TC 220**, Trig 200, **HDL 50**, LDL 145. A1c 5.6%, Fasting Glucose 99 mg/dL

What is her ASCVD risk score? Do you agree? What are your recommendations?



Case 3

35-year-old male presents to establish care. He reports feeling well.

PMHx: Has not seen a provider since he was a child.

FMHx: He doesn't contact his family often.

SocHx: Receptionist at dental office. Single, no children or significant other. Nonsmoker, no EtOH. Exercises 1-2 times a week, lifting at the gym.

MEDS: Occasional "pre-workout protein powder"

Vitals: BP 150/75, HR 60, SaO2 97%, T 98.9, Wt 170 Ht 5'8" BMI 25.8

LABS: TC 200, Trig 135, HDL 40, LDL 120. A1c 5.5%, Fasting Glucose 70 mg/dL

What are your recommendations?



Blood Pressure Physiology

- In simplest terms...

Blood Pressure

Cardiac Output

Peripheral
Vascular
Resistance

Heart Rate

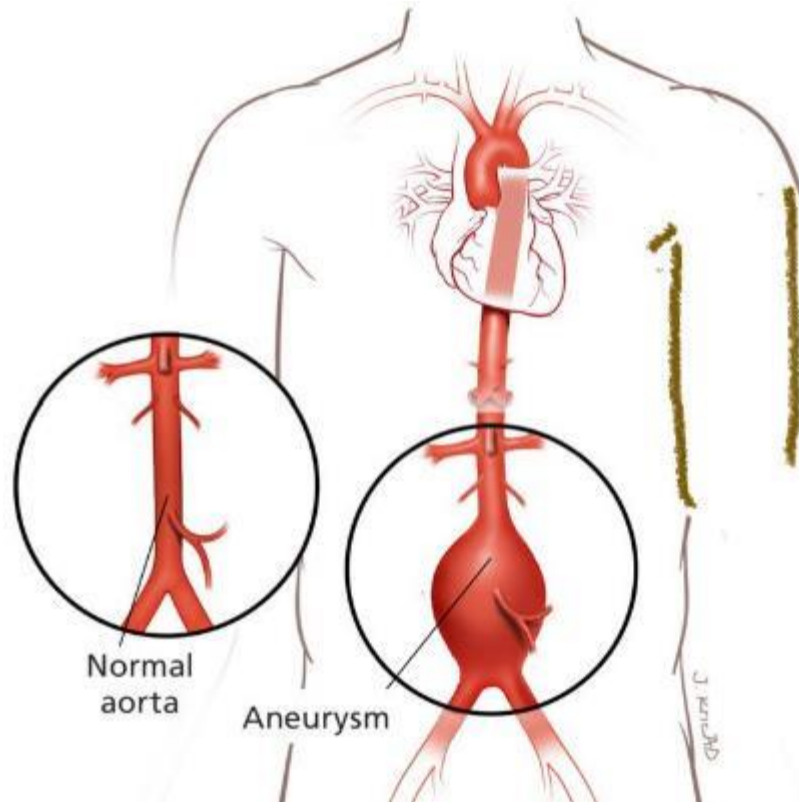
Stroke Volume



Pressure, a force for good and bad



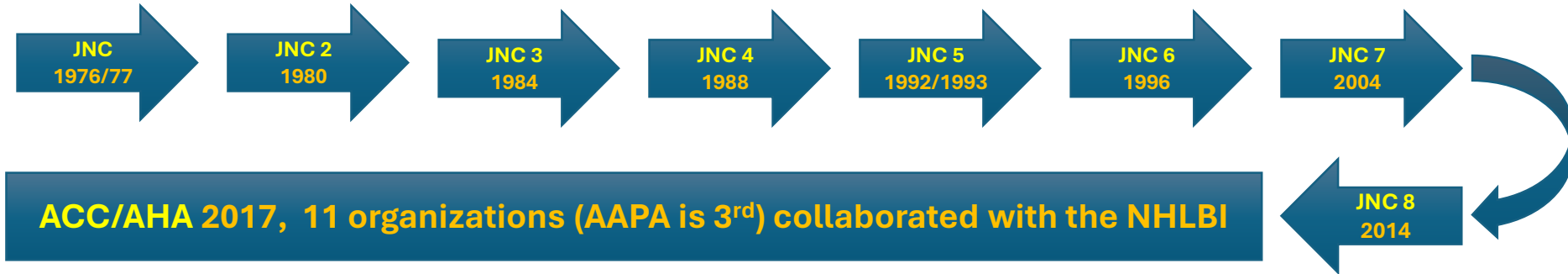
Pressure, a force for good and bad



Level Setting Hypertension

- Which guidelines to use?

The National High Blood Pressure Education Program (NHBPEP)



JNC Task Force I NHBEP, NHLBI "Report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure. A cooperative study. JAMA. 1977;237(3):255-261."

JNC 2 "The 1980 report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure. Arch Intern Med. 1980;140(10):1280-1285."

JNC 3 "The 1984 Report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure. Arch Intern Med. 1984;144:1045-1057."

JNC 4 "The 1988 report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure. Arch Intern Med. 1988;148:1023-1038."

JNC 5 "The fifth report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (JNC V). Arch Intern Med. 1993;153:154-183."

JNC 6 "The sixth report of the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure. Arch Intern Med. 1997;157:2413-2446."

JNC 7 "The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA. 2003;289:2560-2572."

JNC 8 "2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). JAMA."

ACC/AHA "2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines [published correction appears in J Am Coll Cardiol. 2018 May 15;71(19):2275-2279]. J Am Coll Cardiol. 2018;71(19):e127-e248. doi:10.1016/j.jacc.2017.11.006"

2017 Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults

BP Classification (JNC 7 and ACC/AHA Guidelines)

SBP		DBP	JNC 7	2017 ACC/AHA
<120	and	<80	Normal BP	Normal BP
120–129	and	<80	Prehypertension	Elevated BP
130–139	or	80–89	Prehypertension	Stage 1 hypertension
140–159	or	90–99	Stage 1 hypertension	Stage 2 hypertension
≥160	or	≥100	Stage 2 hypertension	Stage 2 hypertension

- Blood Pressure should be based on an average of ≥ 2 careful readings on ≥ 2 occasions
- Adults being treated with antihypertensive medication designated as having hypertension

The short case for adoption of 2017 AHA/ACC BP guidelines

- The risk of CVD doubles for every 20/10 mmHg over 115/75* → 2x risk of CV event AT **135/85**
- JNC 7/8 Guidelines **Stage I HTN** = **≥140/≥90**

Thus: antihypertensive therapies were being considered **AFTER** patients are already ≥2x risk of CV Event



TABLE 3

How low to go with BP? A look at recent systematic reviews and meta-analyses

Publication	Studies and patients	Primary endpoints and results
Xie et al. <i>Lancet</i> . 2016 ¹⁴	19 RCTs including 44,989 patients. Studies had different BP targets or different BP changes in more vs less BP-treated groups.	More intensive BP lowering (mean BP 133/76 mm Hg vs 140/81 mm Hg) was associated with a reduced risk of major CV events (RR=14%; 95% CI, 4-22), MI (13%; 0-24), stroke (22%; 10-32), albuminuria (10%; 3-16), and retinopathy progression (19%; 0-24). No statistically significant difference in HF, CV death, total mortality, or ESRD. No difference in serious adverse events with more intensive vs less intensive treatment (1.35; 0.93-1.97). Severe hypotension was more common (2.68; 1.21-5.89), although AR was small (AR=0.3% vs 0.1% per person-year for the duration of follow-up).
Ettehad et al. <i>Lancet</i> . 2016 ²⁰	123 RCTs including 613,815 patients from large-scale BP trials	A standardized 10-mm Hg reduction in SBP is associated with a reduced risk of major CV events (RR=0.80; 95% CI, 0.77-0.83), CHD (0.83; 0.78-0.88), stroke (0.73; 0.68-0.77), and HF (0.72; 0.67-0.78). No statistically significant difference in renal failure (0.95; 0.84-1.07).
Thomopoulos et al. <i>J Hypertens</i> . 2016 ¹¹	34 RCTs including 138,127 patients. Studies had a group that was more intensively treated than the control group.	More intensive BP lowering is associated with a reduced risk of stroke (RR=0.71; 95% CI, 0.60-0.84), coronary events (0.80; 0.68-0.95), and CV death (0.79; 0.63-0.97). No difference in HF (0.80; 0.49-1.31) or all-cause death (0.83; 0.69-1.03). An SBP/DBP reduction of 10/5 mm Hg across groups stratified by SBP cutoffs of <150, <140, and <130 mm Hg demonstrated similar relative risk reductions, although AR reductions tended to decrease at lower cut-offs.
BP Lowering Treatment Trialists' Collaboration. <i>Lancet</i> . 2014 ¹²	11 RCTs including 67,475 patients randomized to either a BP-lowering drug or placebo or a more intensive or less intensive BP regimen	Using a risk-prediction equation, for each consecutive increase in 5-year CV risk (<11%, 11%-15%, 15%-21%, >21%), BP lowering reduced the risk of CV events in each group ([18%; 95% CI, 7-27]; [15%; 4-25]; [13%; 2-22]; and [15%; 5-24], respectively). Treating 1000 patients in each group with a BP-lowering drug for 5 years would prevent 14, 20, 24, and 38 CV events, respectively.
Bundy et al. <i>JAMA Cardiol</i> . 2017 ¹⁵	42 studies including 144,220 patients. Studies randomized patients to an antihypertensive medication, control, or treatment target, and had to have reported a ≥5-mm Hg difference between comparison groups.	A mean achieved SBP of 120-124 mm Hg was associated with greater reduction in CVD compared with a group with a mean SBP 130-134 mm Hg (HR=0.71; 95% CI, 0.60-0.83), mean SBP 140-144 mm Hg (0.58; 0.48-0.72), mean SBP 150-154 mm Hg (0.46; 0.34-0.63), and mean SBP ≥160 mm Hg (0.36; 0.26-0.51). All-cause mortality in the group with mean achieved SBP 120-124 mm Hg was lower compared with the group with a mean SBP 130-134 mm Hg (0.73; 0.58-0.93), 140-144 mm Hg (0.59; 0.45-0.77), 150-154 mm Hg (0.51; 0.36-0.71), and ≥160 mm Hg (0.47; 0.32-0.67).
Brunström et al. <i>JAMA Intern Med</i> . 2018 ¹⁷	74 studies including 306,273 patients. Studies compared BP-lowering drugs to placebo or different BP goals.	Association of BP-lowering with CV events is dependent on baseline SBP in primary prevention patients. If baseline SBP was ≥160 mm Hg, treatment reduced the risk of death (RR=0.93; 95% CI, 0.87-1.00) and major CV events (0.78; 0.70-0.87). If baseline SBP was 140-159 mm Hg, treatment reduced the risk of death (0.87; 0.75-1.00) and major CV events (0.88; 0.80-0.96). No decrease in mortality or major CV events when baseline SBP was <140 mm Hg (0.98; 0.90-1.06 and 0.97; 0.90-1.04, respectively). In patients with previous CHD, mean baseline SBP of 138 mm Hg reduced the risk of major CV events (0.90; 0.84-0.97), but not survival (0.98; 0.89-1.07).

CONTINUED

TABLE 3

How low to go with BP? A look at recent systematic reviews and meta-analyses (cont'd)

Publication	Studies and patients	Primary endpoints and results
Bavishi et al. <i>J Am Coll Cardiol</i> . 2017 ¹⁸	4 RCTs including 10,857 patients, all of whom were ≥65 years of age	More intensive BP lowering compared with standard BP lowering was associated with a reduced risk of major CV events (RR=0.71; 95% CI, 0.60-0.84), CV mortality (0.67; 0.45-0.98), and HF (0.63; 0.40-0.99). There was no difference in MI (0.79; 0.56-1.12) or stroke (0.80; 0.61-1.05). Serious adverse events and renal failure were more common, but not statistically significant with more intensive BP lowering compared with standard BP lowering (1.02; 0.94-1.09 and 1.81; 0.86-3.80, respectively).
Weiss et al. <i>Ann Intern Med</i> . 2017 ²¹	21 RCTs and 3 observational studies comparing more vs less intensive BP lowering in subjects ≥60 years of age	BP control to <150/90 mm Hg reduced the risk of mortality (RR=0.90; 95% CI, 0.83-0.98), cardiac events (0.77; 0.68-0.89), and stroke (0.74; 0.65-0.84). Lower targets (≤145/85 mm Hg) reduced the risk of cardiac events (0.82; 0.64-1.00) and stroke (0.79; 0.59-0.99), but did not reduce the risk of death (0.86; 0.69-1.06).
Brunström et al. <i>BMJ</i> . 2016 ²²	49 RCTs including 73,738 patients with diabetes mellitus	If baseline SBP was >150 mm Hg, treatment significantly reduced the risk of all-cause mortality (RR=0.89; 95% CI, 0.80-0.99), CV mortality (0.75; 0.57-0.99), MI (0.74; 0.63-0.87), stroke (0.77; 0.65-0.91), and ESRD (0.82; 0.71-0.94), but not HF (0.73; 0.53-1.01). If baseline BP was <140 mm Hg, there was no statistically significant difference in any outcome. When assessing achieved BP, for those with a mean achieved SBP <130 mm Hg, there was a decreased risk of stroke (0.65; 0.42-0.99), but not all-cause mortality (1.10; 0.91-1.33), CV mortality (1.26; 0.89-1.77), MI (0.94; 0.76-1.15), HF (0.93; 0.71-1.21), or ESRD (1.01; 0.71-1.43).
Lv et al. <i>CMAJ</i> . 2013 ¹⁹	11 RCTs including 9287 patients, all of whom had CKD. Studies compared more- vs less-intensive BP targets.	A more intensive BP-lowering strategy reduced the risk of the composite outcome of 50% decline in kidney function or doubling of serum creatinine (HR=0.82; 95% CI, 0.68-0.98) and ESRD (0.79; 0.67-0.93). Intensive BP lowering decreased the risk of kidney failure in patients with proteinuria at baseline (0.73; 0.62-0.86), but not in those without baseline proteinuria (1.12; 0.67-1.82).

AR, absolute risk; BP, blood pressure; CHD, coronary heart disease; CI, confidence interval; CKD, chronic kidney disease; CV, cardiovascular; CVD, cardiovascular disease; DBP, diastolic blood pressure; ESRD, end-stage renal disease; HF, heart failure; HR, hazard ratio; HTN, hypertension; MI, myocardial infarction; RCTs, randomized controlled trials; RR, relative risk; SBP, systolic blood pressure.

<https://www.mdedge.com/diabeteshub/article/168964/cardiology/blood-pressure-targets-how-low-should-you-go-and-whom/page/0/2>

	SBP/DBP \geq 130/80 mm Hg or Self-Reported Antihypertensive Medication†		SBP/DBP \geq 140/90 mm Hg or Self-Reported Antihypertensive Medication‡	
Overall, crude	46%		32%	
	Men (n=4717)	Women (n=4906)	Men (n=4717)	Women (n=4906)
Overall, age-sex adjusted	48%	43%	31%	32%
Age group, y				
20–44	30%	19%	11%	10%
45–54	50%	44%	33%	27%
55–64	70%	63%	53%	52%
65–74	77%	75%	64%	63%
75+	79%	85%	71%	78%
Race-ethnicity§				
Non-Hispanic white	47%	41%	31%	30%
Non-Hispanic black	59%	56%	42%	46%
Non-Hispanic Asian	45%	36%	29%	27%
Hispanic	44%	42%	27%	32%

Differences in HTN goals

- JNC 7, JNC 8, and ACC/AHA 2017

TABLE 2

Recommended BP goals according to JNC 7, JNC 8, and 2017 ACC/AHA guidelines^{1,2,6}

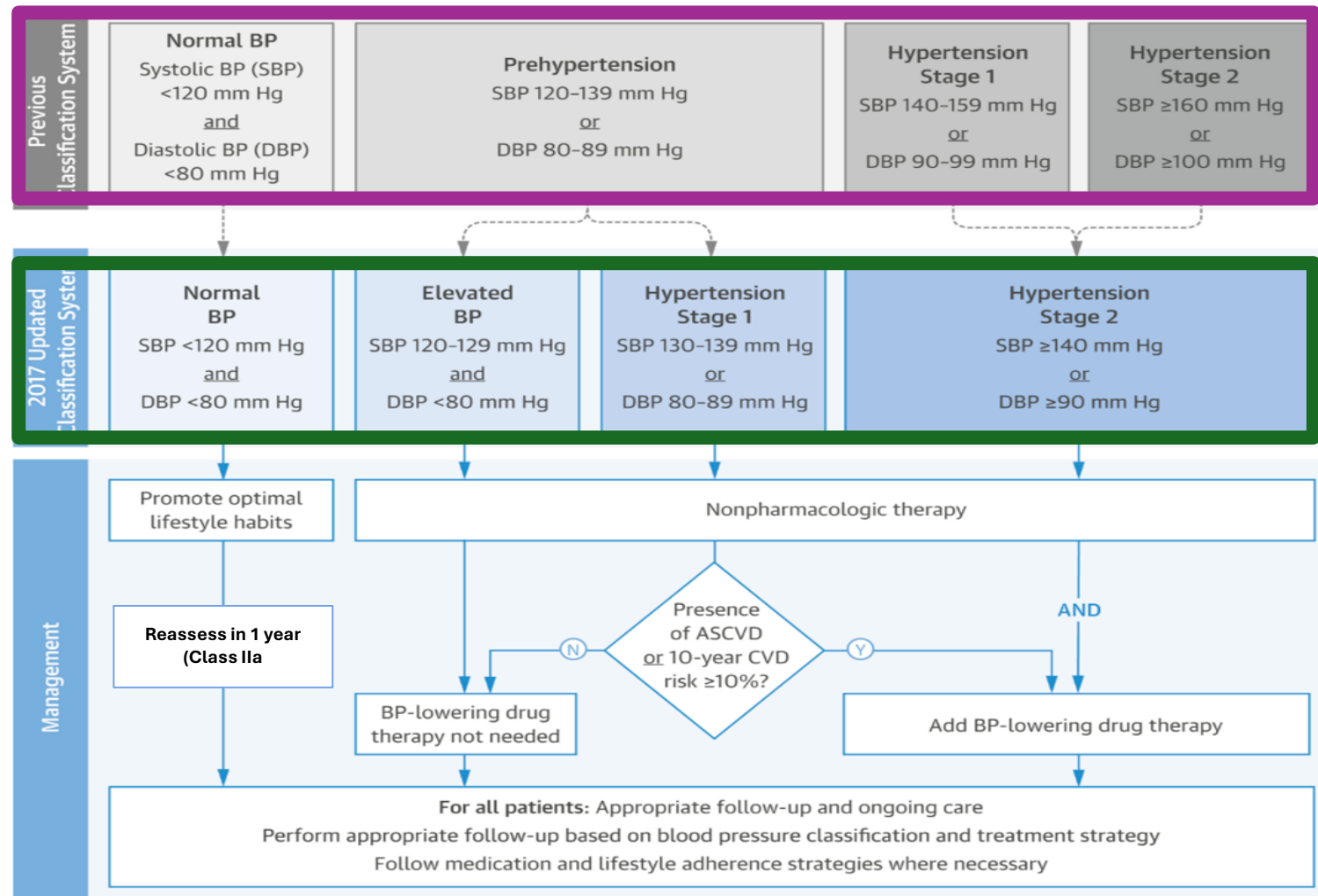
Patient group	JNC 7	JNC 8	2017 ACC/AHA
General →	<140/90 mm Hg	<140/90 mm Hg	<130/80 mm Hg*
Older patients →	<140/90 mm Hg	<150/90 mm Hg [†]	<130 mm Hg [†]
Diabetes →	<130/80 mm Hg →	<140/90 mm Hg	<130/80 mm Hg
Chronic kidney disease →	<130/80 mm Hg →	<140/90 mm Hg	<130/80 mm Hg

ACC, American College of Cardiology; AHA, American Heart Association; BP, blood pressure; JNC 7, Seventh Report of the Joint National Committee; JNC 8, Eighth Joint National Committee.

*Includes patients with atherosclerotic cardiovascular disease (ASCVD) or an estimated 10-year risk $\geq 10\%$, as well as patients needing primary prevention or those with 10-year ASCVD risk $< 10\%$.

[†]General population ≥ 60 years of age. Treatment does not need to be adjusted in patients ≥ 60 years who may have lower systolic BP (eg, < 140 mm Hg) and are not experiencing adverse effects.

[‡]Ambulatory, community-dwelling, noninstitutionalized patients ≥ 65 years of age. Clinical judgment, patient preference, and a team-based approach to assess benefits and risks are reasonable for patients with a high burden of comorbidity and limited life expectancy.



Definition of Hypertension - Primary

- What is ESSENTIAL? Cookie baking ingredients ;)

BAKING POWDER



- gives cookies and artificial, chemical flavor
- results in Play-Doh texture

TOO MUCH FLOUR



- makes cookies dry, crumbly, and chalky

OVER-CREAMED



- cookies become tough and hard

NO EGGS



- taste too sweet
- cookies are dry on the outside and doughy on the inside

EVERYTHING MIXED TOGETHER AT ONCE



- results in inconsistent texture and flavor

NOT ENOUGH FLOUR



- cookies burn easily
- too much grease

NOT ENOUGH SUGAR



- tastes like shortbread
- cookies are dry on the outside and doughy on the inside

OVER-BAKED



- cookies are dry and crumbly
- results in a toasted flavor

Definition of Hypertension - Primary

- What is ESSENTIAL? I would argue while pressure is essential, hypertension is NOT



Low Pressure

Low Pressure



High Pressure



Definition of Hypertension - Primary

- What is ESSENTIAL? I would argue while pressure is essential, hypertension is NOT
- “Essential” - an older term based upon a hypothesis that as we age, our vasculature becomes stiffer, and that higher and higher blood pressures are required to maintain optimal cardiac output.
- Primary - sustained blood pressures meeting criteria (e.g., [ACC/AHA 2017](#)) for hypertension related to multiple genetic and environmental factors.

Blood Pressure Categories



BLOOD PRESSURE CATEGORY	SYSTOLIC mm Hg (upper number)		DIASTOLIC mm Hg (lower number)
NORMAL	LESS THAN 120	and	LESS THAN 80
ELEVATED	120 – 129	and	LESS THAN 80
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1	130 – 139	or	80 – 89
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 2	140 OR HIGHER	or	90 OR HIGHER
HYPERTENSIVE CRISIS (consult your doctor immediately)	HIGHER THAN 180	and/or	HIGHER THAN 120

Hypertension is Essential? I think not.

- SPRINT Trial

Table 1. Baseline Characteristics of the Study Participants.^a

Characteristic	Intensive Treatment (N = 4678)	Standard Treatment (N = 4683)
Criterion for increased cardiovascular risk — no. (%) [†]		
Age ≥75 yr	1317 (28.2)	1319 (28.2)
Chronic kidney disease [‡]	1330 (28.4)	1316 (28.1)
Cardiovascular disease	940 (20.1)	937 (20.0)
Clinical	779 (16.7)	783 (16.7)
Subclinical	247 (5.3)	246 (5.3)
Framingham 10-yr cardiovascular disease risk score ≥15%	3556 (76.0)	3547 (75.7)
Female sex — no. (%)	1684 (36.0)	1648 (35.2)
Age — yr		
Overall	67.9±9.4	67.9±9.5
Among those ≥75 yr of age	79.8±3.9	79.9±4.1

INTENSIVE BLOOD PRESSURE MANAGEMENT MAY SAVE LIVES

WHAT'S THE BEST WAY TO TREAT HIGH BLOOD PRESSURE IN PATIENTS 50 AND OLDER?

The SPRINT trial enrolled more than 9,300 participants at UAB and other locations to find out. Investigators divided them into two groups:

STANDARD TREATMENT



THERAPY:



Avg. 2 different blood pressure medications

INTENSIVE TREATMENT



THERAPY:



Avg. 3 different blood pressure medications

RESULTS: ABOUT **30%** lower rates of heart attack, heart failure, and other cardiovascular events
among participants receiving intensive treatment

ABOUT **25%** lower risk of death

Primary Hypertension

- Primary - Factors that contribute:

Age

Obesity

Family History (2x more common in those w/at least 1 parent with HTN)

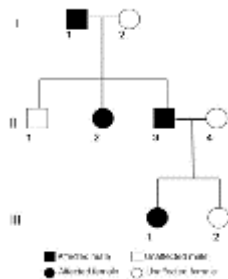
Race

High Na+ Diet

Excessive EtOH

Sedentary lifestyle

Reduced nephron number (acquired or genetic)



Secondary Hypertension

- Secondary - Identifiable cause or contributor to Hypertension

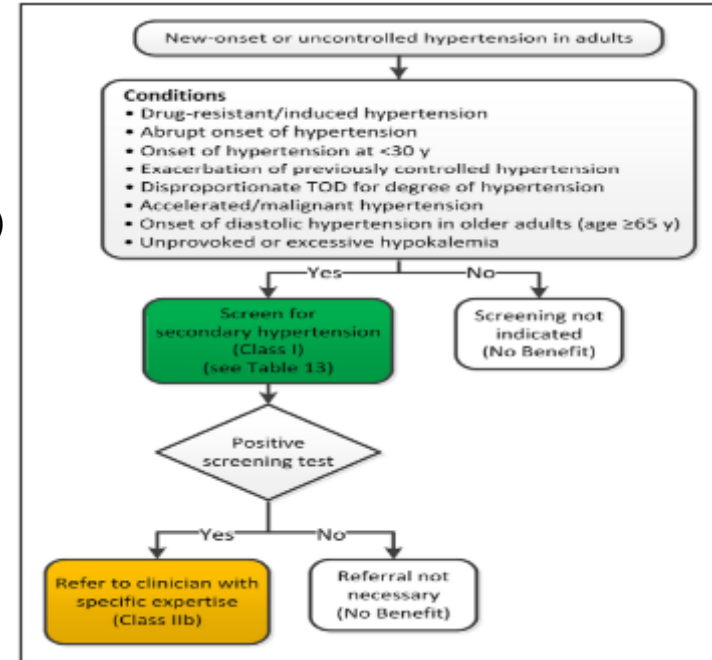
Simplest definition and discovery of secondary hypertension:

- If you treat the primary disease to control, remission, or cure, the hypertension will resolve.

Definition of Hypertension - Secondary

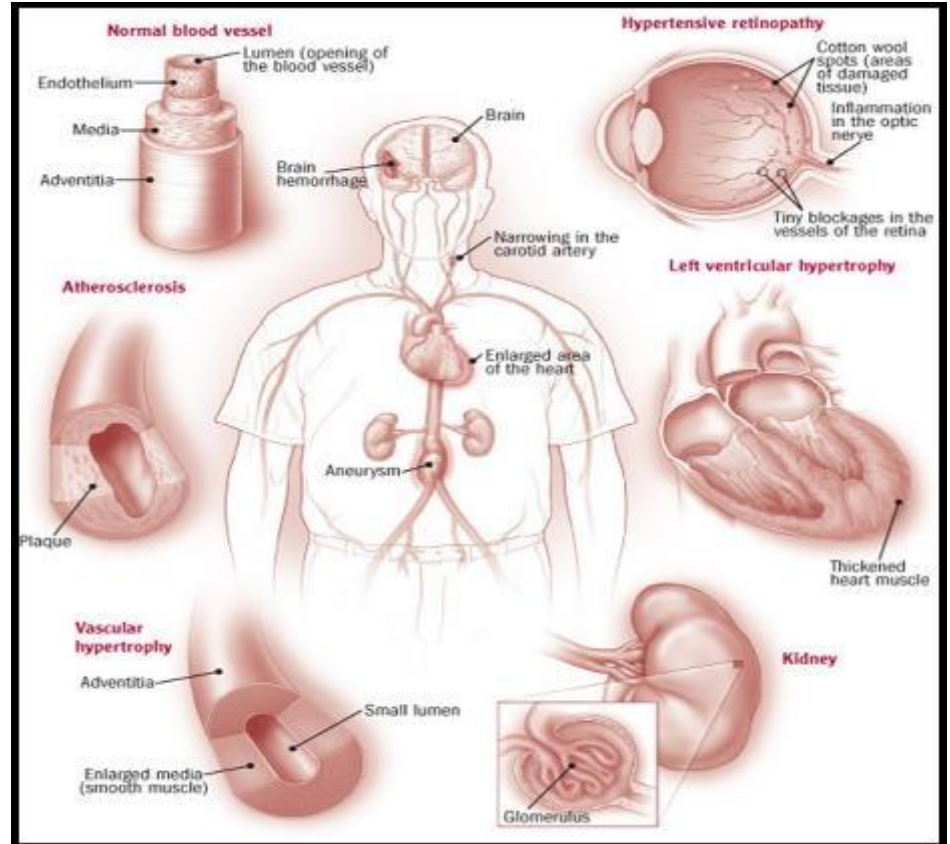
• Secondary - HTN with an identifiable cause or contributor

1. Rx or OTC meds (e.g., NSAIDs, certain weight loss meds, etc.)
2. Primary renal disease
3. Primary aldosteronism
4. Renovascular HTN (e.g., fibromuscular dysplasia, atherosclerosis, etc.)
5. Obstructive or central sleep apnea
6. Pheochromocytoma
7. Cushing's syndrome
8. Other endocrine dysfunction (hypo- hyperthyroidism, etc.)
9. Coarctation of the Aorta
10. Etc.



Complications, Manifestations, Sequelae

- Target Organ Damage
 - **Brain** – CVA/TIA
 - **Eyes** – Retinopathy
 - **Heart** – LVH, CHD, HF, arrhythmias
 - **Kidneys** – nephropathy
 - **Arteries** – Peripheral Vascular disease



Complications, Manifestations, Sequelae

- **Hypertensive Headache?** Not common, can occur...Caveats
- A few small studies suggest that incidence of hypertensive related headache between 15-20% when diastolic BP was between 95 – 125 mmHg, incidence up to 55% when diastolic BP was ≥ 110 mmHg*
- American Heart Association – Hypertensive Headaches can occur when BP $\geq 180/\geq 120$

**Symptom-wise, remember, there is a reason
Hypertension is called the “silent killer”**

Common Travel Companions

- Complications from Hypertension or Co-Morbid Conditions

Modifiable Factors/Conditions	Relatively Fixed Factors/Conditions
Current cigarette smoking, secondhand smoking	CKD
	Family History
Diabetes Mellitus	Increased Age
Dyslipidemia/Hypercholesterolemia	Low Socioeconomic/Educational Status
Overweight/Obesity	Male Sex
Physical Inactivity/Low Fitness	Obstructive Sleep Apnea
Unhealthy Diet	Psychosocial Stress



Common travel companions

- Complications from hypertension or Co-Morbid Conditions

Regardless of whether a complication from previously untreated, uncontrolled hypertension or whether a co-morbid condition, the presence of diabetes, chronic kidney disease, atherosclerotic cardiovascular disease, etc. will provide context for the pharmacologic therapy deployed alongside baseline lifestyle modifications recommended.

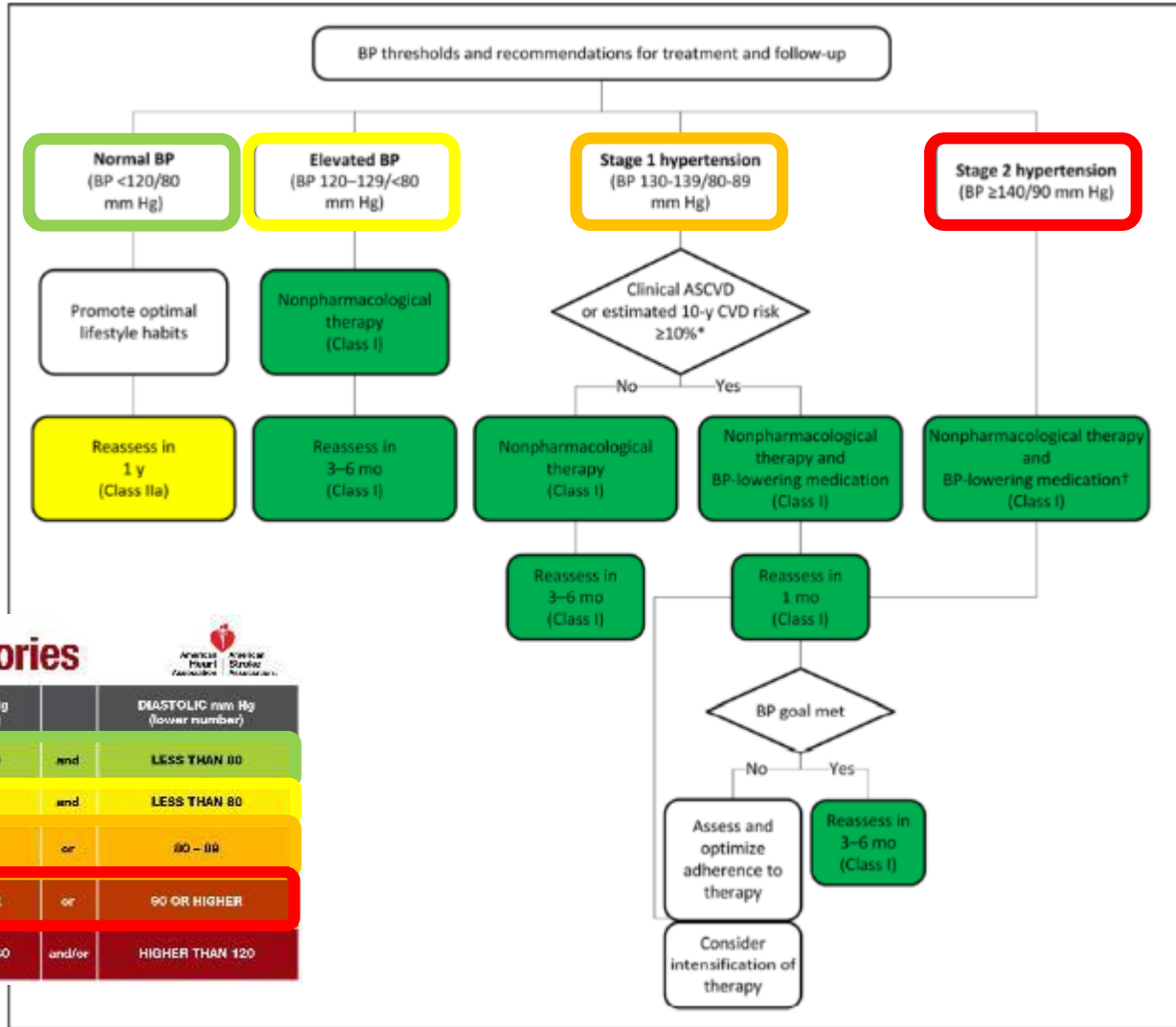
HTN goals ACC/AHA 2017

Patient group	2017 ACC/AHA
General	<130/80 mm Hg*
Older patients	<130 mm Hg [†]
Diabetes	<130/80 mm Hg
Chronic kidney disease	<130/80 mm Hg

*Includes patients with atherosclerotic cardiovascular disease (ASCVD) or an estimated 10-year risk $\geq 10\%$, as well as patients needing primary prevention or those with 10-year ASCVD risk $< 10\%$.

[†]General population ≥ 60 years of age. Treatment does not need to be adjusted in patients ≥ 60 years who may have lower systolic BP (eg, < 140 mm Hg) and are not experiencing adverse effects.

*Ambulatory, community-dwelling, noninstitutionalized patients ≥ 65 years of age. Clinical judgment, patient preference, and a team-based approach to assess benefits and risks are reasonable for patients with a high burden of comorbidity and limited life expectancy.



Blood Pressure Categories

BLOOD PRESSURE CATEGORY	SYSTOLIC mm Hg (upper number)		DIASTOLIC mm Hg (lower number)
NORMAL	LESS THAN 120	and	LESS THAN 80
ELEVATED	120 – 129	and	LESS THAN 80
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1	130 – 139	or	80 – 89
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 2	140 OR HIGHER	or	90 OR HIGHER
HYPERTENSIVE CRISIS (consult your doctor immediately)	HIGHER THAN 180	and/or	HIGHER THAN 120

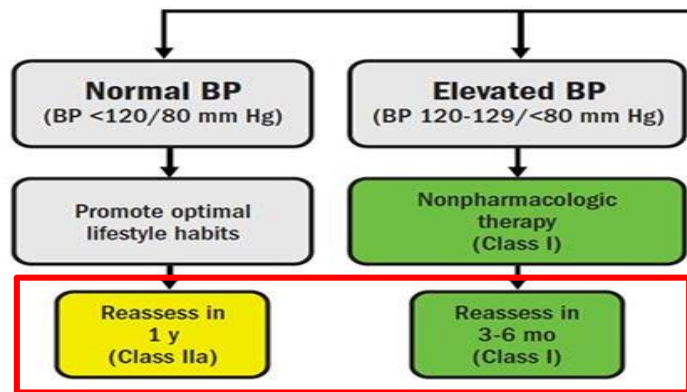
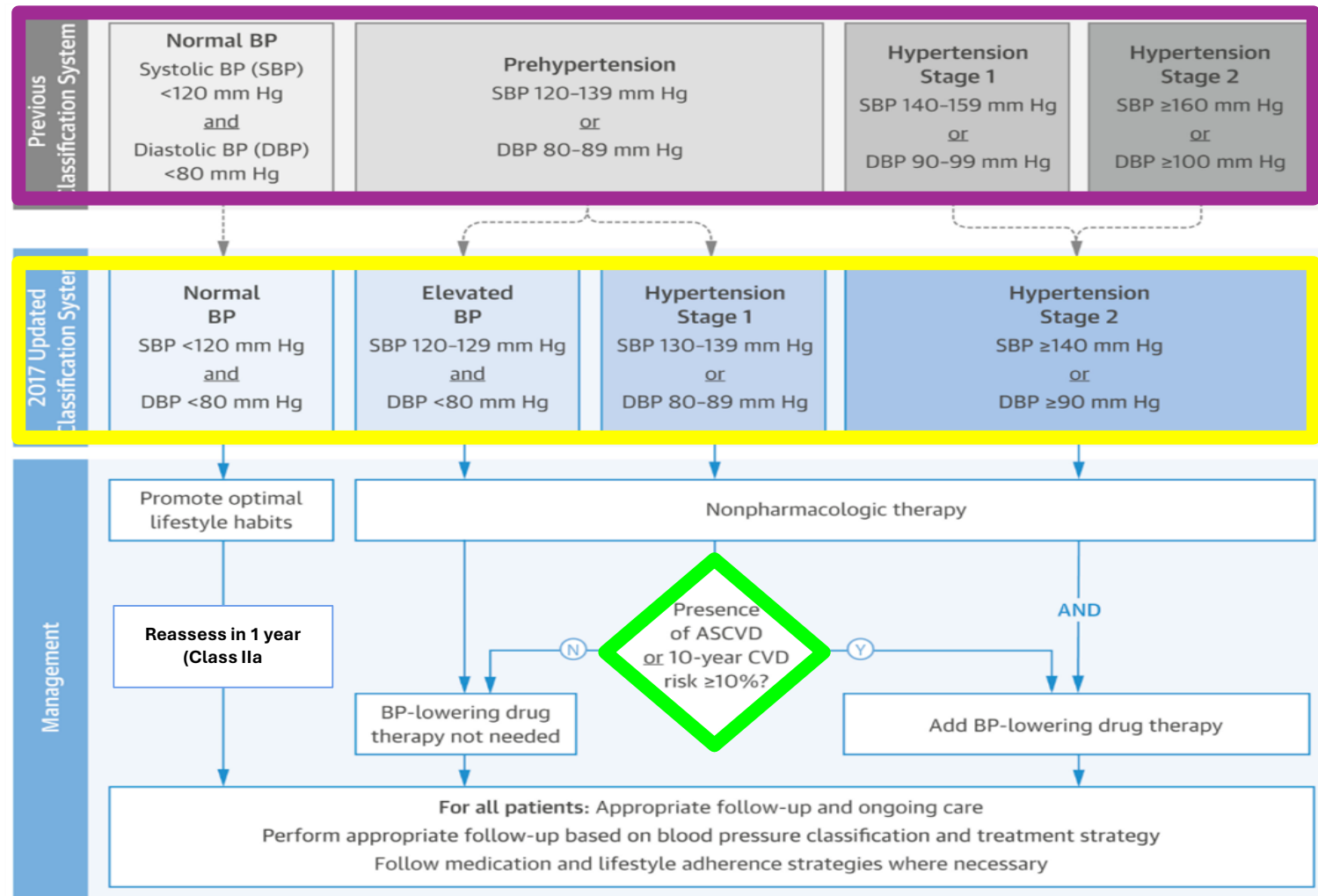


Figure 4, 2017 ACC/AHA Guideline on High Blood Pressure.
See figure in guideline for full details.

Blood Pressure Category	Systolic mmHg (upper number)		Diastolic mmHg (lower number)	Lifestyle/Nonpharmacological therapy	10-year ASCVD Risk Score (< or ≥ 10%)	BP Lowering Medications	Reassess	BP Goal Met (Yes/No)	
NORMAL	< 120	And	< 80	Promote optimal Lifestyle Habits	No need to calculate	-	1 year (Class IIa)	Yes	Ongoing Surveillance and measurement.
								No	
ELEVATED	120-129	And	< 80	Nonpharmacological therapy Class I	No need to calculate	-	3-6 months (Class I)	Yes	Ongoing Surveillance and measurement.
								No	
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1	130-139	Or	80-89	Nonpharmacological therapy Class I	<10%	-	3-6 months (Class I)	Yes	Reassess in 3-6 months (Class I)
								No	Assess and optimize adherence to therapy and consider intensification of therapy
					≥10%	Initiate BP meds (Class I). Single or low-dose combination	1 month (Class I)	Yes	Reassess in 3-6 months (Class I)
								No	Assess and optimize adherence to therapy and consider intensification of therapy
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 2	≥ 140	Or	≥ 90	Nonpharmacological therapy Class I	No need to calculate	Initiate BP meds (Class I). Consider initiation of two agents (1 each from a different class)	1 month (Class I)	Yes	Reassess in 3-6 months (Class I)
								No	Assess and optimize adherence to therapy and consider intensification of therapy



Atherosclerotic Cardiovascular Disease (ASCVD)

- Stroke, coronary artery disease/myocardial infarction, peripheral artery disease.

Needed information

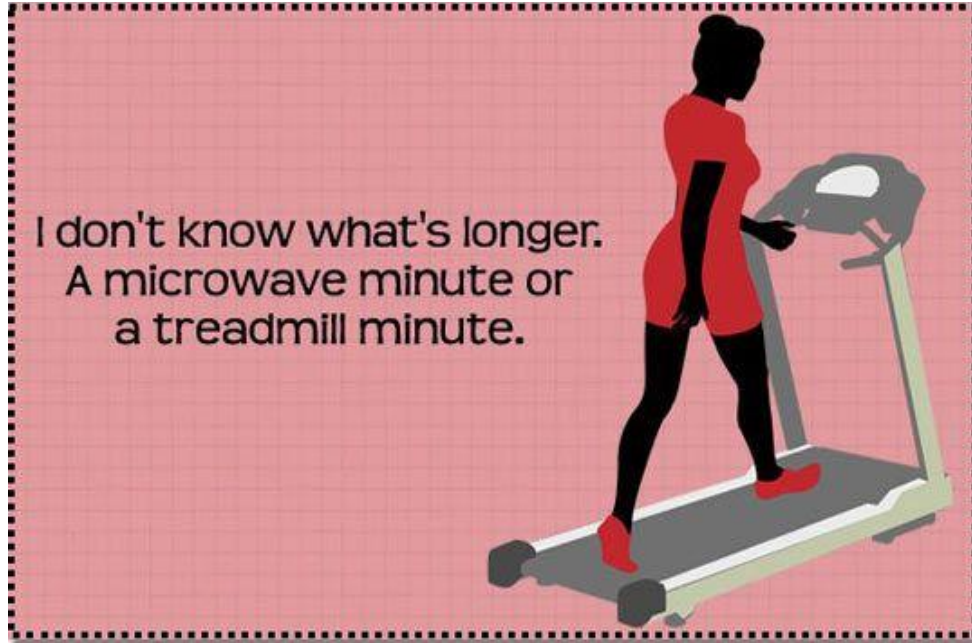
- Age
- Sex
- Race
- SBP
- DBP
- Total cholesterol
- HDL
- Y/N DM I or II
- Y/N Smoking
- Y/N HTN

App should be used for primary prevention patients (those without ASCVD) only.

Current Age ⓘ *	Sex *	Race *
<input type="text"/>	<input type="radio"/> Male <input type="radio"/> Female	<input type="radio"/> White <input type="radio"/> African American <input type="radio"/> Other
<small>Age must be between 20-79</small>		
Systolic Blood Pressure (mm Hg) *	Diastolic Blood Pressure (mm Hg) *	
<input type="text"/>	<input type="text"/>	
<small>Value must be between 90-200</small>	<small>Value must be between 60-130</small>	
Total Cholesterol (mg/dL) *	HDL Cholesterol (mg/dL) *	LDL Cholesterol (mg/dL) ⓘ ○
<input type="text"/>	<input type="text"/>	<input type="text"/>
<small>Value must be between 130 - 320</small>	<small>Value must be between 20 - 100</small>	<small>Value must be between 30-200</small>
History of Diabetes? *	Smoker? ⓘ *	
<input type="radio"/> Yes <input type="radio"/> No	<input type="radio"/> Current ⓘ <input type="radio"/> Former ⓘ <input type="radio"/> Never ⓘ	
On Hypertension Treatment? *	On a Statin? ⓘ ○	On Aspirin Therapy? ⓘ ○
<input type="radio"/> Yes <input type="radio"/> No	<input type="radio"/> Yes <input type="radio"/> No	<input type="radio"/> Yes <input type="radio"/> No

Lifestyle first and foremost

Its about the quality of life we live, not just how long we live it

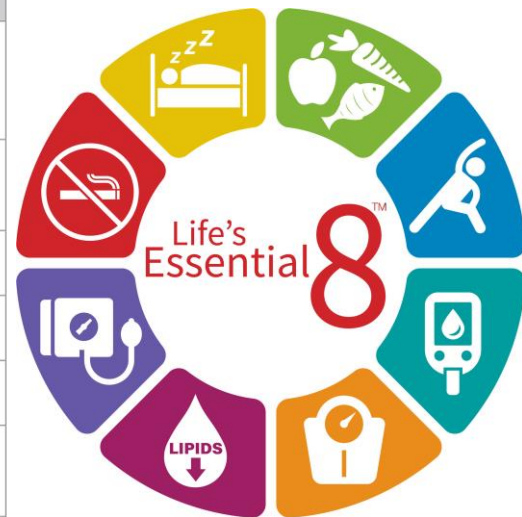


Consider discussing lifestyle modifications not as “work” you do to become healthy. Rather as doing enjoyable activities by yourself or with others that happen to help keep you feeling healthy.

Strongest Recommendation (I), highest level of evidence (Level A)

Table 15. Best Proven Nonpharmacological Interventions for Prevention and Treatment of Hypertension*

	Nonpharmacological Intervention	Dose	Approximate Impact on SBP		
			Hypertension	Normotension	Reference
Weight loss	Weight/body fat	Best goal is ideal body weight, but aim for at least a 1-kg reduction in body weight for most adults who are overweight. Expect about 1 mm Hg for every 1-kg reduction in body weight.	−5 mm Hg	−2/3 mm Hg	S6.2-1
Healthy diet	DASH dietary pattern	Consume a diet rich in fruits, vegetables, whole grains, and low-fat dairy products, with reduced content of saturated and total fat.	−11 mm Hg	−3 mm Hg	S6.2-6,S6.2-7
Reduced intake of dietary sodium	Dietary sodium	Optimal goal is <1500 mg/d, but aim for at least a 1000-mg/d reduction in most adults.	−5/6 mm Hg	−2/3 mm Hg	S6.2-9,S6.2-10
Enhanced intake of dietary potassium	Dietary potassium	Aim for 3500–5000 mg/d, preferably by consumption of a diet rich in potassium.	−4/5 mm Hg	−2 mm Hg	S6.2-13
Physical activity	Aerobic	90–150 min/wk 65%–75% heart rate reserve	−5/8 mm Hg	−2/4 mm Hg	S6.2-18,S6.2-22
	Dynamic resistance	90–150 min/wk 50%–80% 1 rep maximum 6 exercises, 3 sets/exercise, 10 repetitions/set	−4 mm Hg	−2 mm Hg	S6.2-18
	Isometric resistance	4 × 2 min (hand grip), 1 min rest between exercises, 30%–40% maximum voluntary contraction, 3 sessions/wk 8–10 wk	−5 mm Hg	−4 mm Hg	S6.2-19,S6.2-31
Moderation in alcohol intake	Alcohol consumption	In individuals who drink alcohol, reduce alcohol† to: Men: ≤2 drinks daily Women: ≤1 drink daily	−4 mm Hg	−3 mm Hg	S6.2-22—S6.2-24



Weight/Body Fat loss → -5 mmHg

- Loss of 1 kg = ~ -1 mmHg

















BMI tells “a” story. Consider also body fat/composition assessment.

	Healthy Weight						Overweight					Obese					
BMI	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Height	Weight (in pounds)																
4'10"	91	96	100	105	110	115	119	124	129	134	138	143	148	153	158	162	167
4'11"	94	99	104	109	114	119	124	128	133	138	143	148	153	158	163	168	173
5'0"	97	102	107	112	118	123	128	133	138	143	148	153	158	163	168	174	179
5'1"	100	106	111	116	122	127	132	137	143	148	153	158	164	169	174	180	185
5'2"	104	109	115	120	126	131	136	142	147	153	158	164	169	175	180	186	191
5'3"	107	113	118	124	130	135	141	146	152	158	163	169	175	180	186	191	197
5'4"	110	116	122	128	134	140	145	151	157	163	169	174	180	186	192	197	204
5'5"	114	120	126	132	138	144	150	156	162	168	174	180	186	192	198	204	210
5'6"	118	124	130	136	142	148	155	161	167	173	179	186	192	198	204	210	216
5'7"	121	127	134	140	146	153	159	166	172	178	185	191	198	204	211	217	223
5'8"	125	131	138	144	151	158	164	171	177	184	190	197	203	210	216	223	230
5'9"	128	135	142	149	155	162	169	176	182	189	196	203	209	216	223	230	236
5'10"	132	139	146	153	160	167	174	181	188	195	202	209	216	222	229	236	243
5'11"	136	143	150	157	165	172	179	186	193	200	208	215	222	229	236	243	250
6'0"	140	147	154	162	169	177	184	191	199	206	213	221	228	235	242	250	256
6'1"	144	151	159	166	174	182	189	197	204	212	219	227	235	242	250	257	265
6'2"	148	155	163	171	179	186	194	202	210	218	225	233	241	249	256	264	272
6'3"	152	160	168	176	184	192	200	208	216	224	232	240	248	256	264	272	279
6'4"	156	164	172	180	189	197	205	213	221	230	238	246	254	263	271	279	287

DASH Eating Plan → -11 mmHg

DASH Eating Plan

The Benefits: Lowers blood pressure & LDL “bad” cholesterol.

 Eat This	 Limit This
 Vegetables	 Fatty meats
 Fruits	
 Whole grains	 Full-fat dairy
 Fat-free or low-fat dairy	
 Fish	 Sugar sweetened beverages
 Poultry	
 Beans	 Sweets
 Nuts & seeds	
 Vegetable oils	 Sodium intake

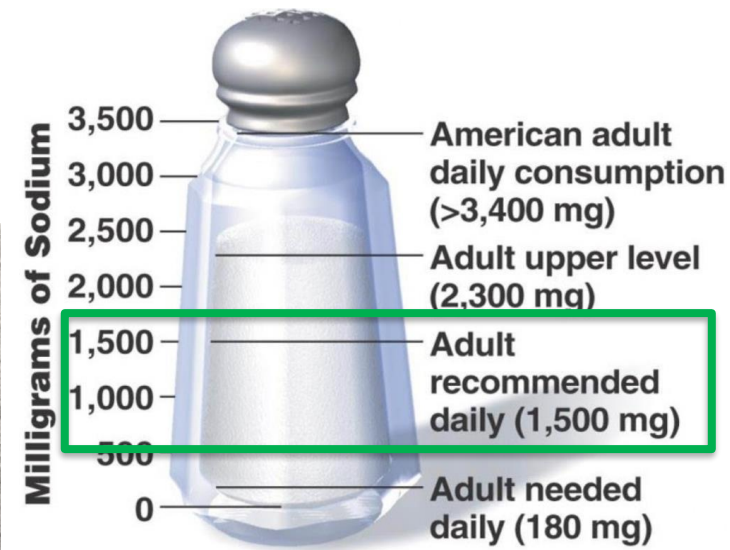
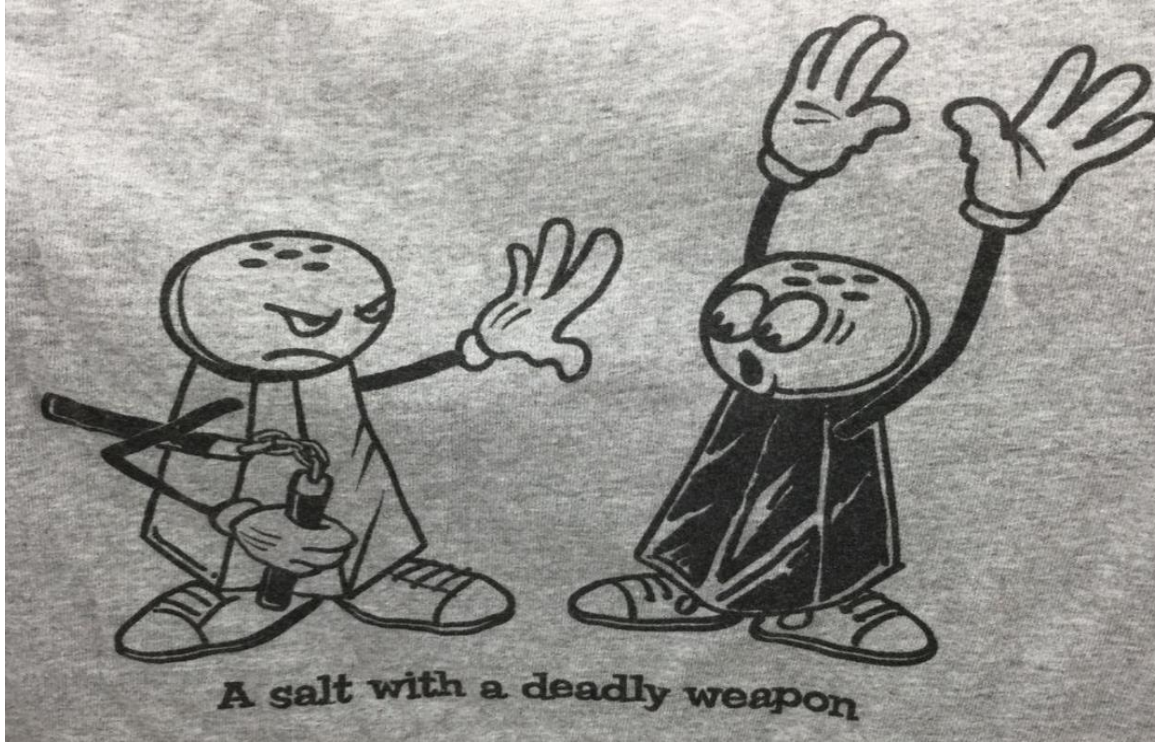
www.nhlbi.nih.gov/DASH

Simply Stated:

Eat **MORE:** Fruits, Vegetables, Whole Grains, Unsaturated Fats & Oils, Lean Proteins and Low-Fat Dairy

Eat **LESS:** Saturated Fats and Sugars

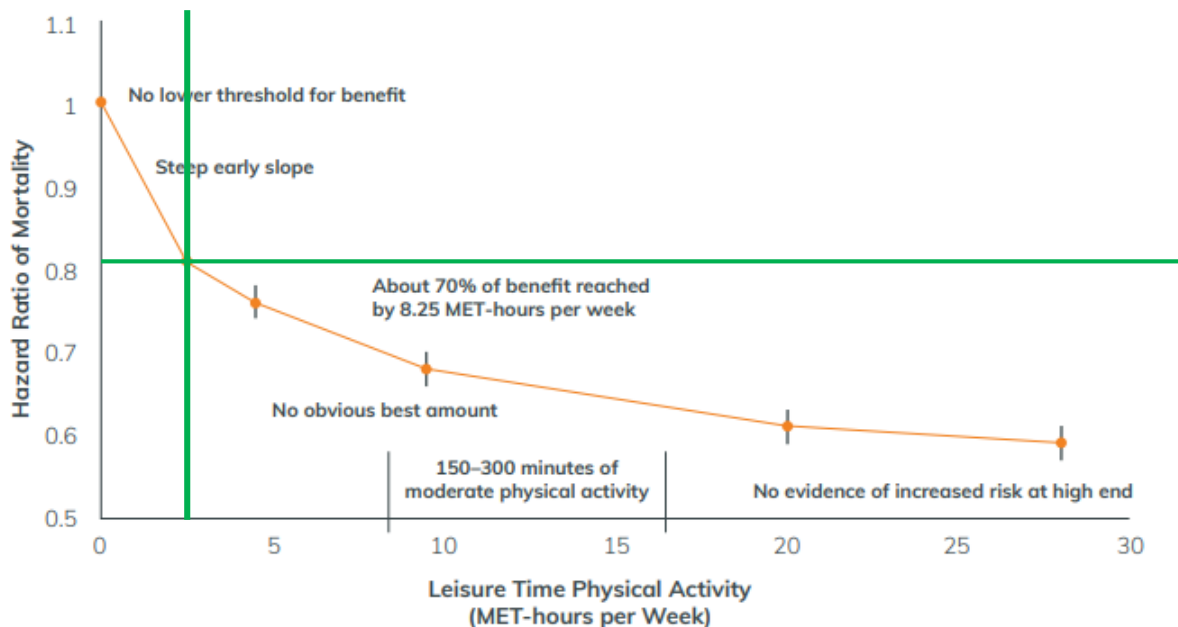
Reduce Sodium → -5/6 mmHg



Most important lesson of physical activity


- Anything leisure time activity is better than nothing.

Figure 2-1. Relationship of Moderate-to-Vigorous Physical Activity to All-Cause Mortality



Source: Adapted from data found in Moore SC, Patel AV, Matthews CE. Leisure time physical activity of moderate to vigorous intensity and mortality: a large pooled cohort analysis. PLoS Med. 2012;9(11):e1001335. doi:10.1371/journal.pmed.1001335.

American Heart Association Physical Activity Recommendations → -4 to 8 mmHg

 The American Heart Association
Recommendations for Physical
Activity in Adults

For Overall Cardiovascular Health:

At least **30** minutes of moderate-intensity aerobic activity **5** days per week for a total of **150** minutes

OR

At least **25** minutes of vigorous aerobic activity **3** days per week for a total of **75** minutes

or a combination of the two

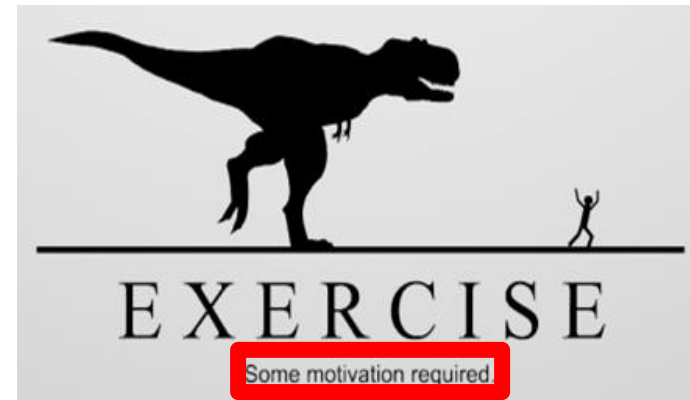
AND

Moderate to **HIGH INTENSITY** muscle-strengthening activity **2** days per week for additional health benefits

For Lowering Blood Pressure and Cholesterol:

An average **40** minutes of moderate- to vigorous-intensity aerobic activity **3-4** days per week

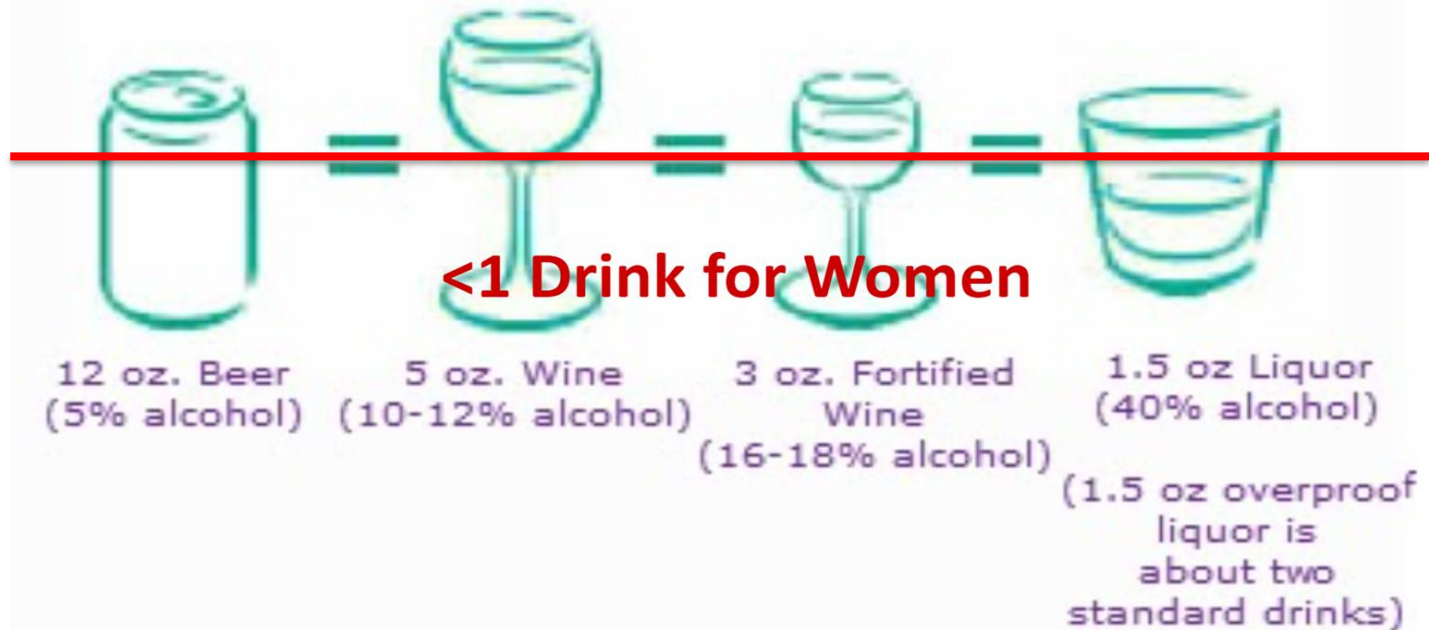
© 2016 Learn more at heart.org/ActivityRecommendations.



Alcohol → **-4 mmHg**

Moderation...

One Standard Drink is:



When to consider medications?

Risk Stratification + Blood pressure staging

- Stage 1 ($\geq 130/\geq 80$) hypertension AND 10-year ASCVD risk of $<10\%$, IF BP still elevated between 3-6 months after non-pharmacologic (i.e., lifestyle) therapy initiation
- Stage 1 ($\geq 130/\geq 80$) hypertension and 10-year ASCVD risk of $\geq 10\%$
- Stage 2 ($\geq 140/\geq 90$) hypertension, consider 2 agents of different classes
- Very high BP ($\geq 180/\geq 110$) evaluate and prompt antihypertensive treatment

Pharmacologic approaches

Monotherapy, low(er)-dose combination, or max-out then add-on

Rationale for low(er) fixed dose combination therapies over monotherapy for initial therapy:

- Combination of 2 agents at low doses gives greater blood pressure reductions than higher dose of 1 drug
- Fewer adverse effects (than high dose monotherapy)
- Blockade of several pathways that increase blood pressure
- Increased protection of target organs
- Prompt blood pressure control
- Effects independent of their antihypertensive actions
- Improved adherence in combination vs single add-ons

Pharmacologic approaches

Night-time or morning/daytime

There is a diurnal pattern of higher blood pressure in the morning and a decline in the late evening well described on 24-48 hour Ambulatory BP Monitoring (ABPM). There are those who do not experience dipping – so-called “non-dippers”. This is associated with stroke, MI, and cardiovascular death.

- Several studies have shown reduced new-onset DM, improved 24-hour blood pressure, and more importantly, reduction in cardiovascular events with **night-time dosing** versus morning/daytime.

Medication class for hypertension is like putting out a fire

- Not enough, not the right liquid, think of fire mechanism



Pharmacotherapeutics

Initiation, what to start with? First line and/or condition driven

Regardless of underlying conditions, **start with agents that have data for clinical outcomes benefits**, i.e., have clinical trial data demonstrating reduction of CVD events, CKD progression, etc.

Primary agents used in the treatment of hypertension include:

- **thiazide diuretics** – (e.g., chlorthalidone, hydrochlorothiazide, indapamide, etc.)
- **ACE inhibitors** – (e.g., enalapril, lisinopril, benazepril, etc.)
- **ARBs** – (e.g., candesartan, irbesartan, losartan, etc.)
- **CCBs dihydropyridine** – (e.g., amlodipine, felodipine, nicardipine, etc.)
- **CCBs nondihydropyridine** – (e.g., diltiazem and verapamil)

Case 1

45-year-old female presents to establish care. She reports feeling well.

PMHx: Hypothyroidism. OB/GYN: No pre-eclampsia. Last menses 3 weeks ago.

FMHx: Mother had MI at age 65, 2 stents. Father is A&W.

SocHx: Bank manager. Married with 2 children. **Current smoker** and drinks 1-3 glasses of wine a week with dinner. Does not follow any specific physical activity regimen.

MEDS: levothyroxine 88 mcg qd, MVI

Vitals: BP **135/85**, HR 80, SaO2 96%, T 98.9, Wt 165 Ht 5'5" BMI 27.5

LABS: **TC 220**, Trig 200, **HDL 50**, LDL 145. A1c 5.6%, Fasting Glucose 99 mg/dL

- What is her ASCVD risk score? Do you agree? What are your recommendations?



The screenshot shows a medical history form for a 45-year-old female patient. The form includes fields for Current Age (45), Sex (Female), Race (White), and various blood pressure and cholesterol readings. The patient is a current smoker, has a history of diabetes, and is on hypertension treatment. The form also includes checkboxes for being on a statin and aspirin therapy.

Current Age	Sex	Race
45	Female	White

Systolic Blood Pressure (mm Hg)	Diastolic Blood Pressure (mm Hg)

Total Cholesterol (mg/dL)	HDL Cholesterol (mg/dL)	LDL Cholesterol (mg/dL)

History of Diabetes?	Smoker?
Yes No	Current Former Never

On Hypertension Treatment?	On a Statin?	On Aspirin Therapy?
Yes No	Yes No	Yes No

Stage 1 - $\geq 130/\geq 80$, ASCVD $<10\%$

- Lifestyle modifications for health, e.g., smoking cessation, etc.
- Teach self measurement and keep a home BP journal
- Reassess progress at 3-6 months

HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1	130-139	Or	80-89	Nonpharmacological therapy Class I	<10%	-	3-6 months (Class I)	Yes	Reassess in 3-6 months (Class I)
								No	Assess and optimize adherence to therapy and consider intensification of therapy

Case 2

63-year-old female presents for annual follow-up. She reports feeling well.

PMHx: Occasional headaches OB/GYN: Post-menopausal since early 50's.

FMHx: Sister suffered MI at age 65, 3vCABG. Parents have passed. 2 brothers, 1 with DMII.

SocHx: Medical Technologist, working part-time. Married with 2 adult children. **Current smoker**, no EtOH. Does not follow any specific physical activity regimen.

MEDS: Ibuprofen 400 mg PRN for headaches, MVI.

Vitals: BP **135/85**, HR 80, SaO2 96%, T 98.9, Wt 155 Ht 5'5" BMI 25.8

LABS: **TC 220**, Trig 200, **HDL 50**, LDL 145. A1c 5.6%, Fasting Glucose 99 mg/dL

What is her ASCVD risk score? Do you agree? What are your recommendations?

The screenshot shows a medical risk calculator interface. At the top, it displays a calculated risk of 10.6% for the current 10-year ASCVD risk and an optimal risk of 3.2%. Below this, patient information is entered: Current Age 63, Sex Female, Race White, and Ethnicity African American. Medical history includes Systolic Blood Pressure (135), Diastolic Blood Pressure (85), Total Cholesterol (220), HDL Cholesterol (50), LDL Cholesterol (145), and History of Diabetes (No). Current treatments for hypertension, statins, and aspirin are all marked as 'No'.

Stage 1 - $\geq 130/\geq 80$, ASCVD $\geq 10\%$

1. Lifestyle modifications for health
2. BP lowering medication – absent risk factors, **chlorthalidone 25 mg** is reasonable.
3. Teach self measurement and keep a home BP journal
4. Reassess at 1 month

HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1	130-139	Or	80-89	Nonpharmacological therapy Class I					
					≥10%	Initiate BP meds (Class I). Single or low-dose combination	1 month (Class I)	Yes	Reassess in 3-6 months (Class I)
								No	Assess and optimize adherence to therapy and consider intensification of therapy



Case 3

35-year-old male presents to establish care. He reports feeling well.

PMHx: Has not seen a provider since he was a child.

FMHx: He doesn't contact his family often.

SocHx: Receptionist at dental office. Single, no children or significant other. Nonsmoker, no EtOH. Exercises 1-2 times a week, lifting at the gym.

MEDS: Occasional "pre-workout protein powder"

Vitals: BP 150/75, HR 60, SaO₂ 97%, T 98.9, Wt 170 Ht 5'8" BMI 25.8

LABS: TC 200, Trig 135, HDL 40, LDL 120. A1c 5.5%, Fasting Glucose 70 mg/dL

What are your recommendations?

Stage 2 - $\geq 140/\geq 90$

1. Lifestyle modifications for health
2. BP lowering medication, consider two agents – absent risk factors, **chlorthalidone 12 (or 25) mg and lisinopril 5 (or 10-20) mg** is reasonable.
3. Teach self measurement and keep a home BP journal
4. Reassess at 1 month

HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 2	≥140	Or	≥ 90	Nonpharmacological therapy Class I	No need to calculate	Initiate BP meds (Class I). Consider initiation of two agents (1 each from a different class)	1 month (Class I)	Yes	Reassess in 3-6 months (Class I)
								No	Assess and optimize adherence to therapy and consider intensification of therapy

Resistance

When blood pressure refuses to be controlled

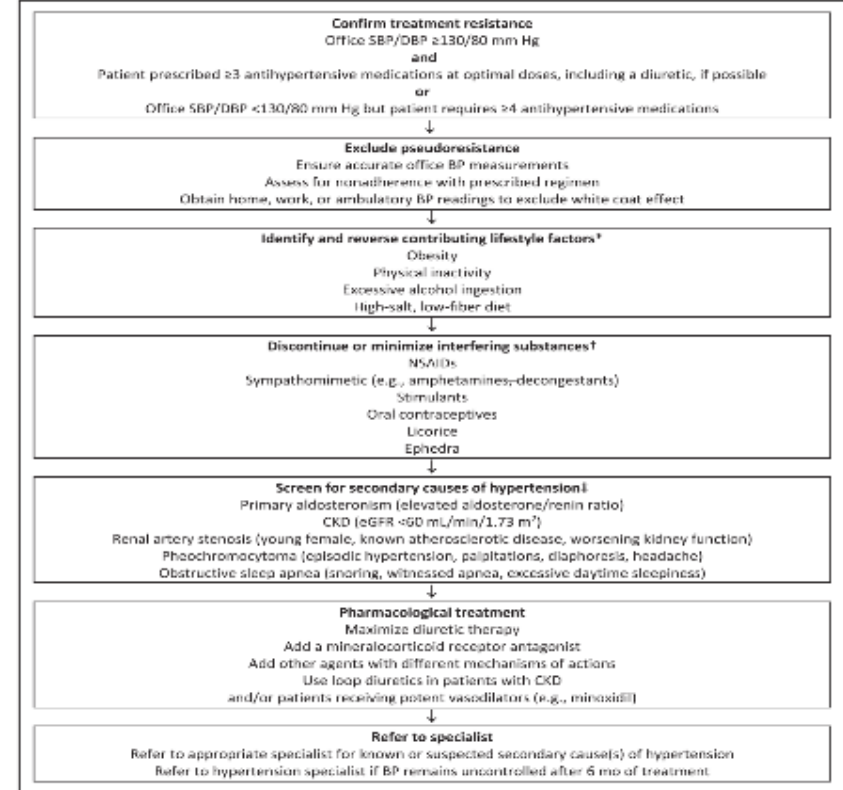


Resistance? Recheck secondary causes

On average, it takes 2 and ½ BP medications to control BP

After 3 medications (one from three different classes, e.g., thiazide, ACEi/ARB, and CCB), if BP is still above goal:

- Reassess for modifiable secondary causes.
- Treat/Refer for treatment of secondary cause.



Specific diseases and populations

BP goals (<130/<80) are the same. Individuals and disease are not.

Stable Ischemic Heart Disease – GDMT Bblockers, ACEi/ARB.

- Angina Pectoris, present = DHP CCB, not present = DHP CCBs, thiazides, MRA

HFrEF – GDMT Bblockers, ACEi/ARB/ARNI, MRA. NDHP CCB NOT recommended.

CKD – albuminuria (≥ 300 mg/day or ≥ 300 mg/g creatinine by first morning void) is present, ACEi, ARB if ACEi not tolerated.

DM – All first line medications (e.g., thiazides, ACEi/ARB, DHP/NDHP CCBs) are reasonable.

Specific diseases and populations

BP goals (<130/<80) are the same. Individuals and disease are not.

- African American, Black – Thiazides and DHP/NDHP CCB are recommended first line.
- Pregnant Women – methyldopa, nifedipine, and/or labetalol.
- Age >65 – **If** high burden of comorbidity and limited life expectancy, **then** clinical judgment, patient preference, and a team-based approach to assess risk/ benefit is reasonable for decisions regarding intensity of BP lowering and choice of antihypertensive drug

Summary

1. Utilize the latest guidelines, 2017 AHA/ACC
2. Blood Pressures $\geq 130/\geq 80$ = HYPERTENSION
3. Goal in almost all people, across disease and populations = $< 130/< 80$
4. PROMOTE OPTIMAL LIFESTYLE, ALWAYS
5. 1st Line BP classes also have evidence for outcome benefit – Thiazides (specifically chlorthalidone), ACEi/ARB, CCBs.
6. Individualize therapy to population and disease, consider low(er)-combination doses before maximal single, educate and engage patients.