CMHC
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Foundations of Cardiometabolic Health Certification Course

Certified Cardiometabolic Health Professional (CCHP)

Treatment of Hypertension: Lifestyle and Pharmacologic Approaches

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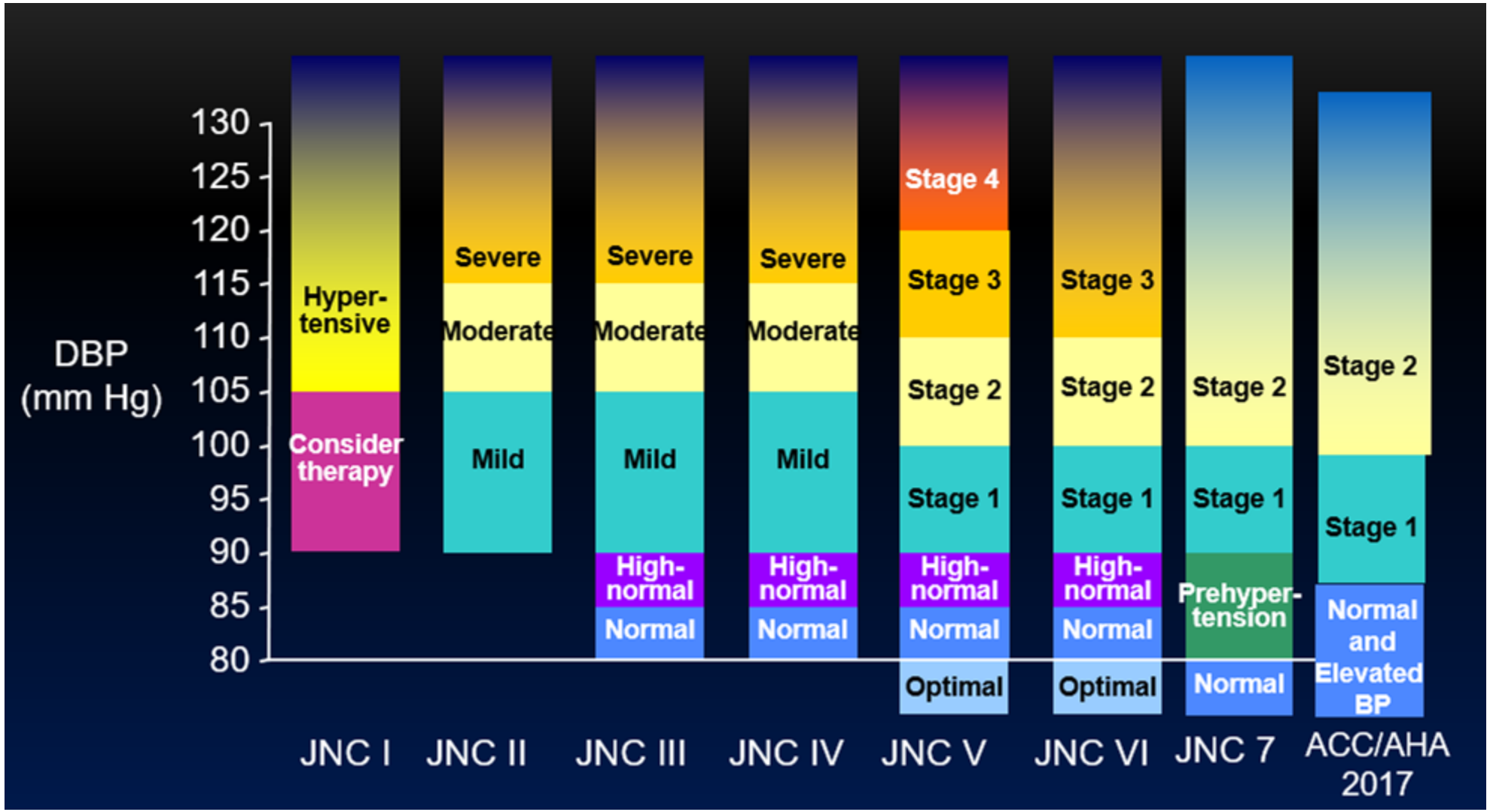
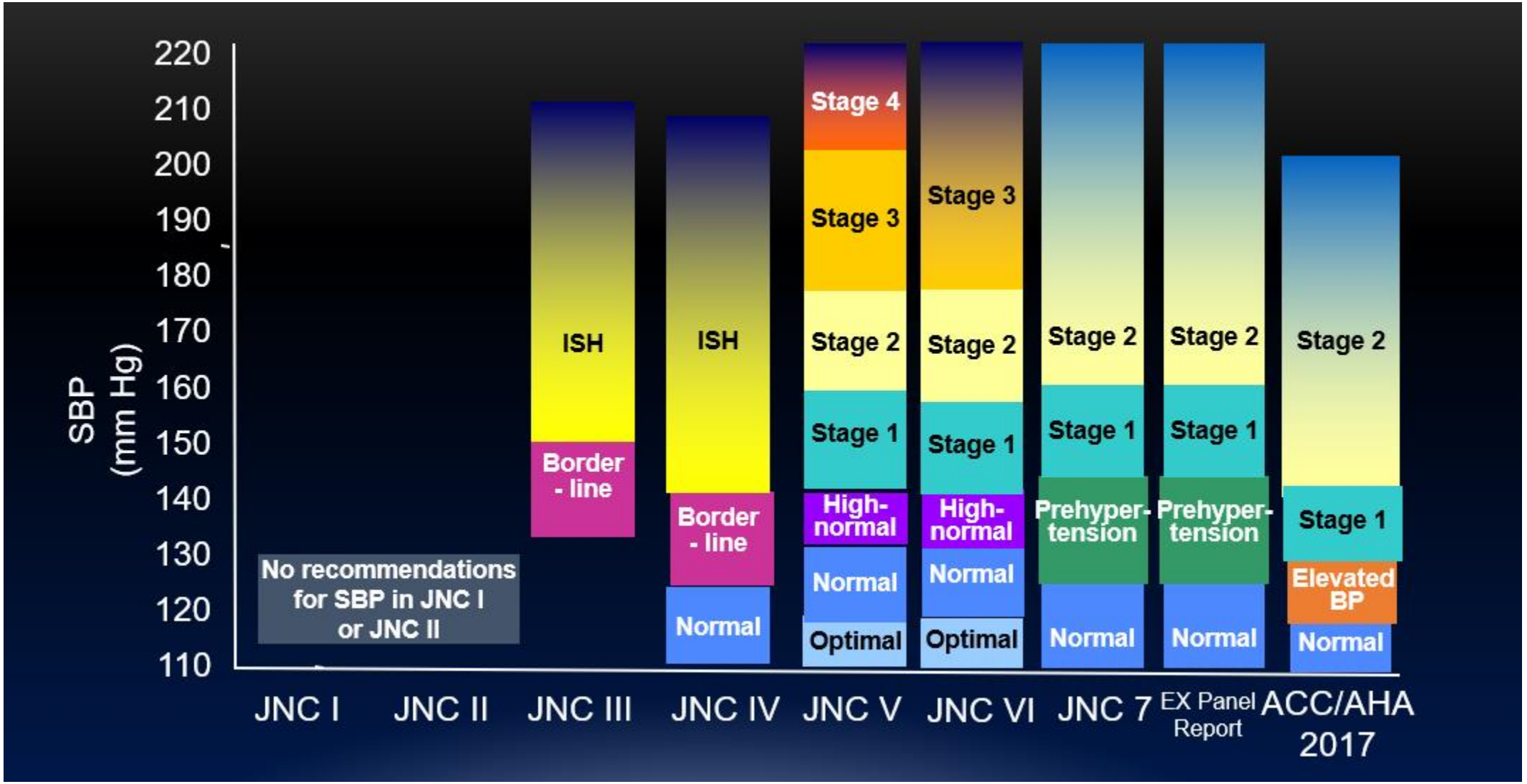
Like physical guidelines designed to ensure that hikers stay on the safest path through tricky terrain, expert medical guidelines aim to steer clinicians towards best practices.

JNC/AHA/ACC BP CLASSIFICATIONS: DBP



JNC I. *JAMA.* 1977;237:255-261.; JNC II. *Arch Intern Med.* 1980;140:1280-1285; JNC III. *Arch Intern Med.* 1984;144:1047-1057. JNC IV. *Arch Intern Med.* 1988;148:1023-1038; JNC V. *Arch Intern Med.* 1993;153:154-183. JNC VI. *Arch Intern Med.* 1997;157:2413-2446.;JNC 7. *JAMA.* 2003;289:2560-2572; Expert Panel Report-JAMA 2014;311:507-520; ACC/AHA BP Guidelines Hypertension 2018

JNC/AHA-ACC BP CLASSIFICATIONS: SBP



JNC I. JAMA. 1977;237:255-261.; JNC II. Arch Intern Med. 1980;140:1280-1285.;JNC III. Arch Intern Med. 1984;144:1047-1057.
JNC IV. Arch Intern Med. 1988;148:1023-1038; JNC V. Arch Intern Med. 1993;153:154-183.; JNC VI. Arch Intern Med. 1997;157:2413-2446.; JNC 7. JAMA. 2003;289:2560-2572.; Expert Panel Report-JAMA 2014;311:507-520; ACC/AHA BP Guidelines Hypertension 2018

NATIONAL HIGH BLOOD PRESSURE EDUCATION PROGRAM COORDINATING COMMITTEE

American Academy of Family Physicians
American Academy of Neurology
American Academy of Ophthalmology
American Academy of Physician Assistants
American Association of Occupational Health Nurses
American College of Cardiology
American College of Chest Physicians
American College of Occupational and Environmental Medicine
American College of Physicians
—American Society of Internal Medicine
American College of Preventive Medicine
American Dental Association
American Diabetes Association
American Dietetic Association
American Heart Association
American Hospital Association
American Medical Association
American Nurses Association
American Optometric Association
American Osteopathic Association
American Pharmaceutical Association
American Podiatric Medical Association
American Public Health Association
American Red Cross
American Society of Health-System Pharmacists
American Society of Hypertension
American Society of Nephrology
Association of Black Cardiologists
Citizens for Public Action on High Blood Pressure and Cholesterol, Inc.
Hypertension Education Foundation, Inc.
International Society on Hypertension in Blacks
National Black Nurses Association, Inc.
National Hypertension Association, Inc.
National Kidney Foundation, Inc.
National Medical Association
National Optometric Association
National Stroke Association
NHLBI Ad Hoc Committee on Minority Populations
Society for Nutrition Education
The Society of Geriatric Cardiology

Federal Agencies:

Agency for Healthcare Research and Quality
Centers for Medicare & Medicaid Services
Department of Veterans Affairs
Health Resources and Services Administration
National Center for Health Statistics
National Heart, Lung, and Blood Institute
National Institute of Diabetes and Digestive and Kidney Diseases

AHA/ACC focus on CV risk to determine BP goals

- For adults with confirmed hypertension and greater than 10% 10-year CVD event risk, a BP target of < 130/80 mm Hg is recommended

Whelton, Paul K., et al. *Journal of the American College of Cardiology* 71.19 (2018): e127-e248.

Coexistence of hypertension and related chronic conditions

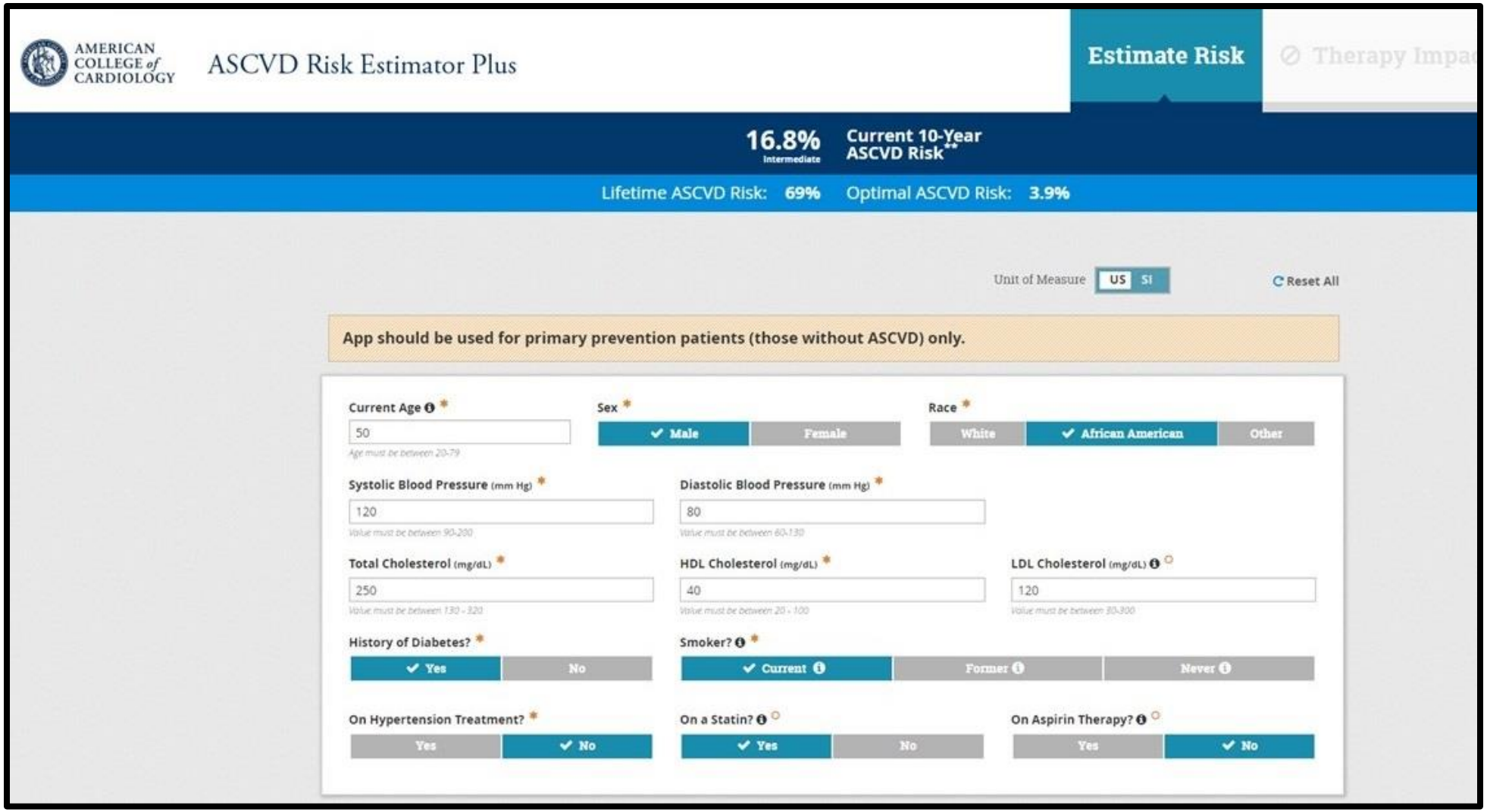
COR	LOE	Recommendation for Coexistence of Hypertension and Related Chronic Conditions
I	B-NR	Screening for and management of other modifiable CVD risk factors are recommended in adults with hypertension.

Whelton, Paul K., et al. *Journal of the American College of Cardiology* 71.19 (2018): e127-e248.

CVD Risk factors common in patients with hypertension

Modifiable Risk Factors*	Relatively Fixed Risk Factors†
· Current cigarette smoking, secondhand smoking · Diabetes mellitus · Dyslipidemia/hypercholesterolemia · Overweight/obesity · Physical inactivity/low fitness · Unhealthy diet	· CKD · Family history · Increased age · Low socioeconomic/educational status · Male sex · Obstructive sleep apnea · Psychosocial stress

ASCVD RISK CALCULATOR



https://itunes.apple.com/us/app/ascvd-risk-estimator/id808875968?mt=8
https://tools.acc.org/ascvd-risk-estimator-plus/#!/calculate/estimate/

BP MEASUREMENT

CHECKLIST FOR ACCURATE MEASUREMENT OF BP

Key Steps for Proper BP Measurements
Step 1: Properly prepare the patient.
Step 2: Use proper technique for BP measurements.
Step 3: Take the proper measurements needed for diagnosis and treatment of elevated BP/hypertension.
Step 4: Properly document accurate BP readings.
Step 5: Average the readings.
Step 6: Provide BP readings to patient.

Both guidelines stress proper cuffs be used selection criteria for BP cuff size for measurement of BP in adults

Arm Circumference	Usual Cuff Size
22–26 cm	Small adult
27–34 cm	Adult
35–44 cm	Large adult
45–52 cm	Adult thigh

Whelton, Paul K., et al. *Journal of the American College of Cardiology* 71.19 (2018): e127-e248.

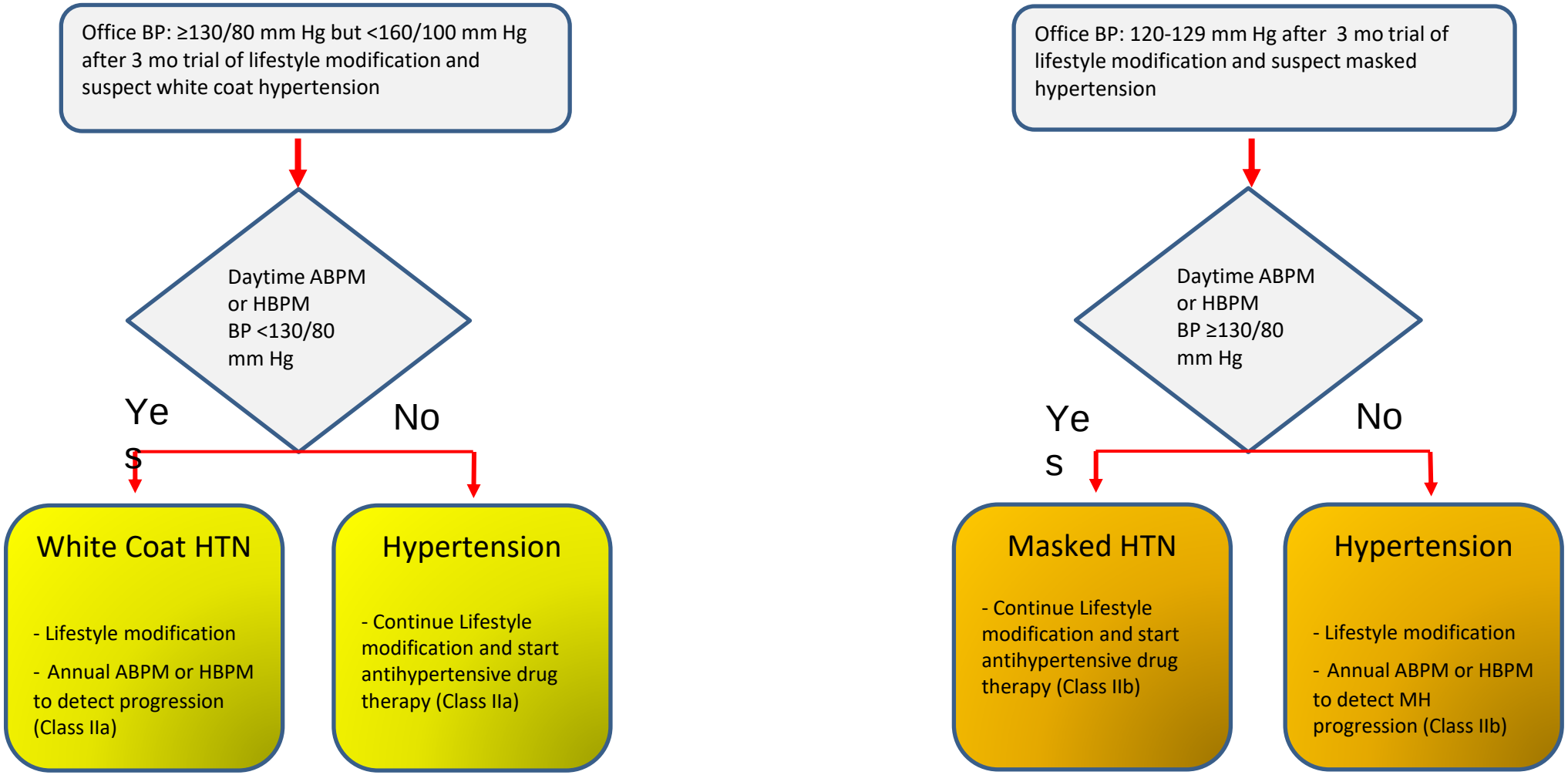
Out-of-office and self-monitoring of BP

COR	LOE	Recommendation for Out-of-Office and Self-Monitoring of BP
I	A^{SR}	Out-of-office BP measurements are recommended to confirm the diagnosis of hypertension and for titration of BP-lowering medication, in conjunction with telehealth counseling or clinical interventions.

SR indicates systematic review.

Whelton, Paul K., et al. *Journal of the American College of Cardiology* 71.19 (2018): e127-e248.

Detection of White Coat Hypertension or Masked Hypertension in Patients Not on Drug Therapy



Colors correspond to Class of Recommendation in Table 1.
ABPM indicates ambulatory blood pressure monitoring; BP, blood pressure; and HBPM, home blood pressure monitoring.

Whelton, Paul K., et al. *Journal of the American College of Cardiology* 71.19 (2018): e127-e248.

Comparison of ambulatory blood pressure monitoring and home blood pressure monitoring

ABPM	HBPM
Advantages • Can identify white-coat and masked hypertension • Stronger prognostic evidence • Night-time readings • Measurement in real-life settings • Additional prognostic BP phenotypes • Abundant information from a single measurement session, including short-term BP variability	Advantages • Can identify white-coat and masked hypertension • Cheap and widely available • Measurement in a home setting, which may be more relaxed than the doctor's office • Patient engagement in BP measurement • Easily repeated and used over longer periods to assess day-to-day BP variability
Disadvantages • Expensive and sometimes limited availability • Can be uncomfortable	Disadvantages • Only static BP is available • Potential for measurement error • No nocturnal readings[a]

ABPM = ambulatory blood pressure monitoring; BP = blood pressure; HBPM = home blood pressure monitoring.
[a] Techniques are being developed to enable nocturnal BP measurement with home BP devices.

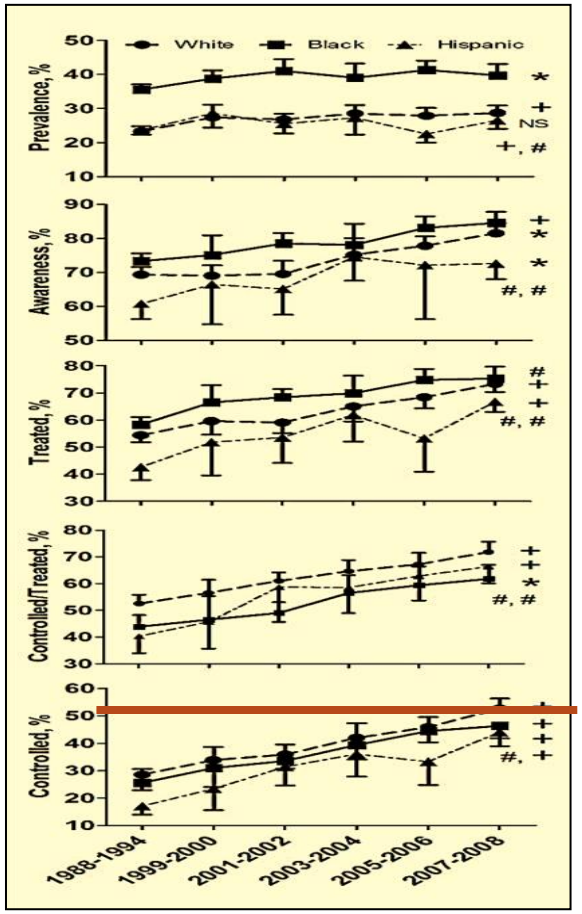
Williams B et.al. European Heart Journal (2018) 39, 3021–3104

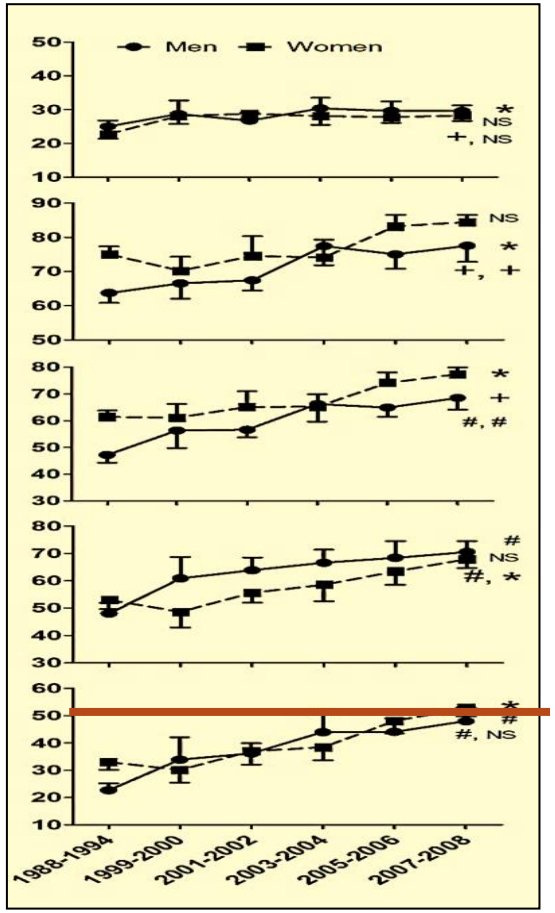
Categories of BP in Adults*

BP Category	SBP		DBP
Normal	<120 mm Hg	and	<80 mm Hg
Elevated	120–129 mm Hg	and	<80 mm Hg
Hypertension			
Stage 1	130–139 mm Hg	or	80–89 mm Hg
Stage 2	≥140 mm Hg	or	≥90 mm Hg

***Individuals with SBP and DBP in 2 categories should be designated to the higher BP category.**
BP indicates blood pressure (based on an average of ≥2 careful readings obtained on ≥2 occasions, as detailed in DBP, diastolic blood pressure; and SBP systolic blood pressure.

Prevalence, Awareness, Treatment, for 1988–1994 & and Control 1999–2008





Egan B et.al. JAMA 2010;303:2043-2050

Trends in Age-adjusted Prevalence of Hypertension and Elevated BP Defined by the 2017 ACC/AHA New Criteria: United States, 1999-2016

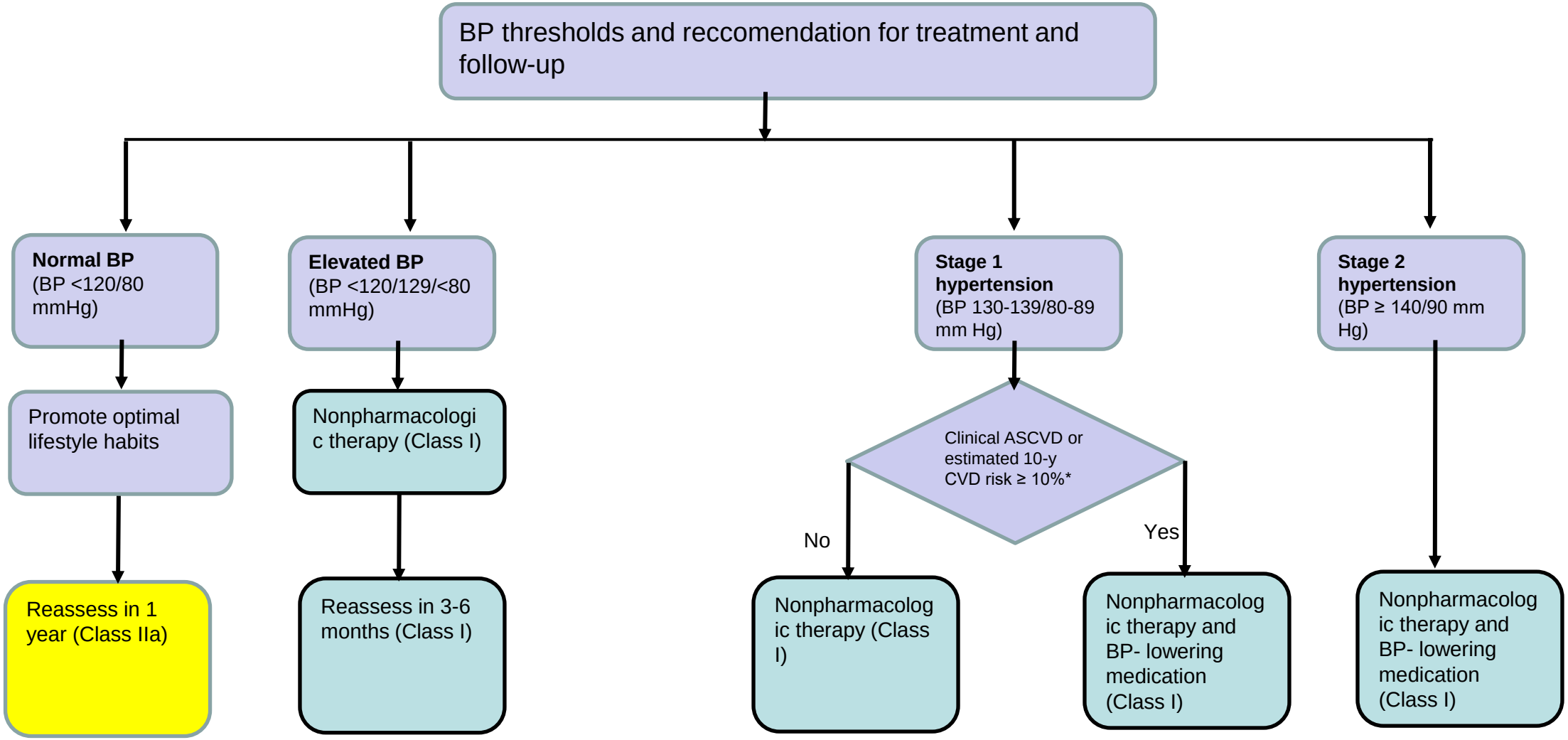
Liu B et.al. JAMA Internal Med 2018

Best Proven Nonpharmacologic Interventions for Prevention and Treatment of Hypertension*

			Approximate Impact SBP	
	Nonpharmacologic Intervention	**Dose**	**Hypertension**	**Normotension**
Physical activity	Aerobic	● 90-150 min/wk ● 65%-75% heart rate reserve	-5/8 mm Hg	-2/4 mm Hg
	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
	Isometric Resistance	● 4 x 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
Healthy diet	DASH dietary pattern	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
Weight loss	Weight/body fat	Ideal body weight is best goal but at least 1 kg reduction in body weight for most adults who are overweight	-5 mm Hg	-2/3 mm Hg
Reduced intake of dietary sodium	Dietary sodium	<1,500 mg/d is optimal goal but at least 1,000 mg/d reduction in most adults	-5/6 mm Hg	-2/3 mm Hg
Enhanced intake of dietary potassium	Dietary potassium	3,500-5,000 mg/d, preferably by consumption of a diet rich in potassium	-4/5 mm Hg	-2 mm Hg
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

Whelton, Paul K., et al. *Journal of the American College of Cardiology* 71.19 (2018): e127-e248.

Blood Pressure (BP) Thresholds and Recommendations for Treatment and Follow-Up



Whelton, Paul K., et al. *Journal of the American College of Cardiology* 71.19 (2018):

Initiation of hypertension treatment according to office BP

Recommendations	Class[a]	Level[b]
Prompt initiation of BP-lowering drug treatment is recommended in patients with grade 2 or 3 hypertension at any level of CV risk, simultaneous with the initiation of lifestyle changes	I	A

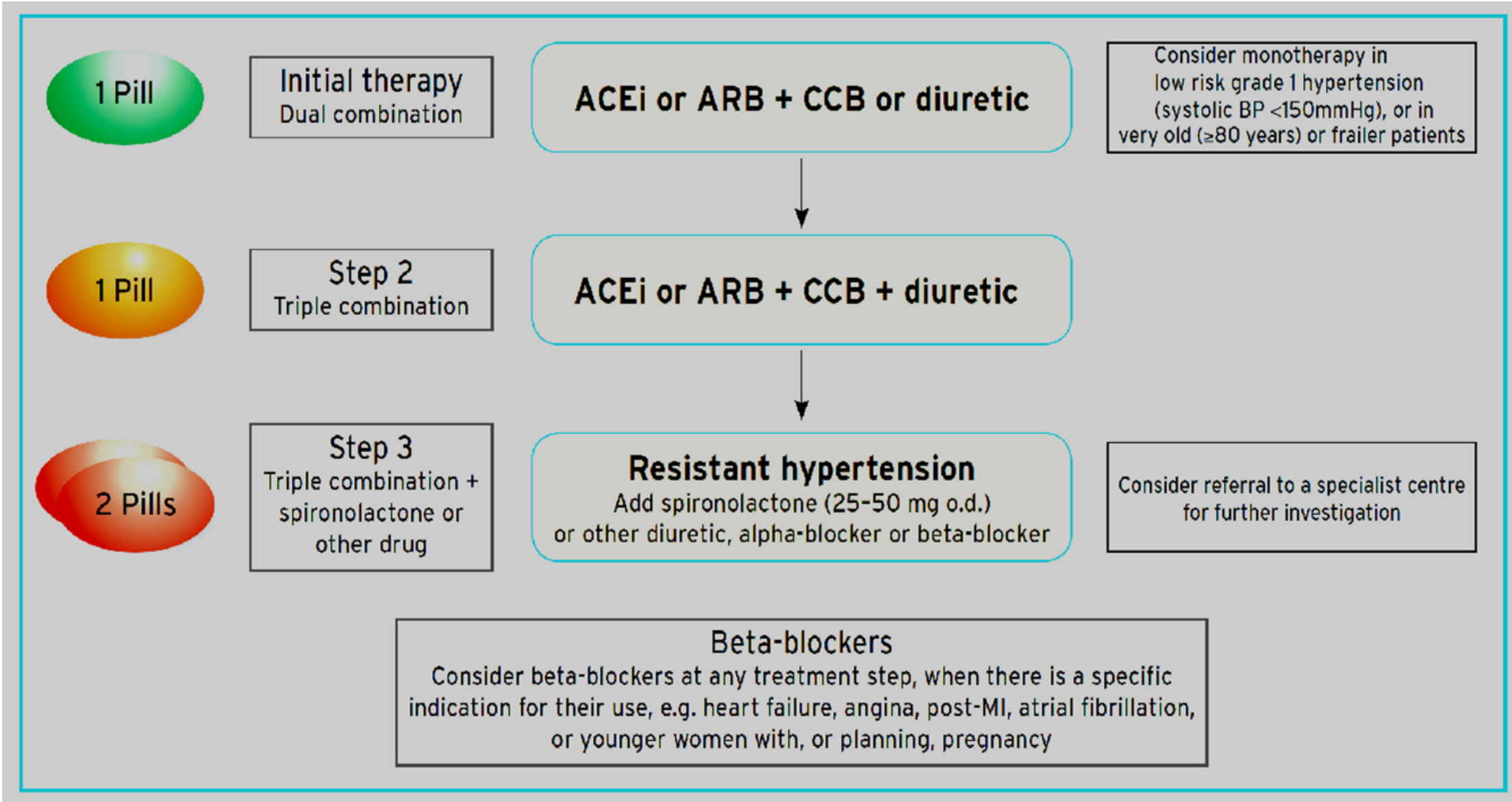
Williams B et.al. European Heart Journal (2018) 39, 3021–3104

AHA/ACC 2017

COR	LOE	Recommendation for Choice of Initial Medication
I	A^{SR}	For initiation of antihypertensive drug therapy, first-line agents include thiazide diuretics, CCBs, and ACE inhibitors or ARBs.

COR	LOE	Recommendations for Choice of Initial Monotherapy Versus Initial Combination Drug Therapy*
I	C-EO	Initiation of antihypertensive drug therapy with 2 first-line agents of different classes, either as separate agents or in a fixed-dose combination, is recommended in adults with stage 2 hypertension and an average BP more than 20/10 mm Hg above their BP target.
IIa	C-EO	Initiation of antihypertensive drug therapy with a single antihypertensive drug is reasonable in adults with stage 1 hypertension and BP goal <130/80 mm Hg with dosage titration and sequential addition of other agents to achieve the BP target.

ESC/ESH 2018



Williams B et.al Eur Heart J 2018

Racial and Ethnic Differences in Treatment

COR	LOE	Recommendations for Race and Ethnicity
I	B-R	In black adults with hypertension but without HF or CKD, including those with DM, initial antihypertensive treatment should include a thiazide-type diuretic or CCB.
I	C-LD	Two or more antihypertensive medications are recommended to achieve a BP target of less than 130/80 mm Hg in most adults with hypertension, especially in black adults with hypertension.

Whelton, Paul K., et al. *Journal of the American College of Cardiology* 71.19 (2018):

Chronic Kidney Disease

COR	LOE	Recommendations for Treatment of Hypertension in Patients With CKD
I	SBP: B-R[SR]	Adults with hypertension and CKD should be treated to a BP goal of less than 130/80 mm Hg.
	DBP: C-EO	
IIa	B-R	**In adults with hypertension and CKD (stage 3 or higher or stage 1 or 2 with albuminuria [≥300 mg/d, or ≥300 mg/g albumin-to-creatinine ratio or the equivalent in the first morning void]), treatment with an ACE inhibitor is reasonable to slow kidney disease progression.**
IIb	C-EO	**In adults with hypertension and CKD (stage 3 or higher or stage 1 or 2 with albuminuria [≥300 mg/d, or ≥300 mg/g albumin-to-creatinine ratio in the first morning void]), treatment with an ARB may be reasonable if an ACE inhibitor is not tolerated.**

Whelton, Paul K., et al. *Journal of the American College of Cardiology* 71.19 (2018):

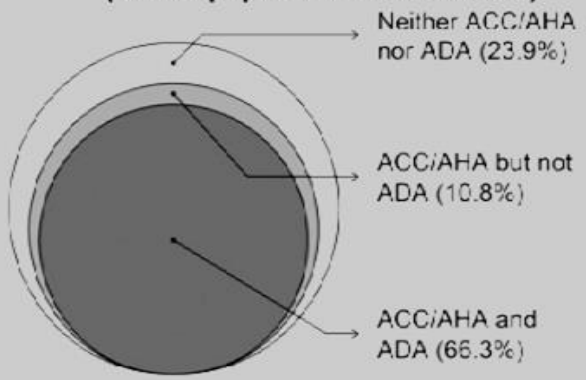
DIABETES STATEMENTS from AHA/ACC 2017 BP Guidelines

- In adults with DM and hypertension, antihypertensive drug treatment should be initiated at a BP greater than or equal to 130/80 mm Hg with a treatment goal of less than 130/80 mm Hg **(Level 1 B)**
- In adults with DM and hypertension, all classes of antihypertensive agents are useful and effective **(Level 1A)**
- In adults with DM and hypertension, ACE inhibitors or ARBs may be considered in the presence of albuminuria **(Level 2B)**

Percentage of US Adults with Diabetes:
Estimates from recent NHANES

Those with HTN

Prevalence of hypertension (overall population with diabetes)

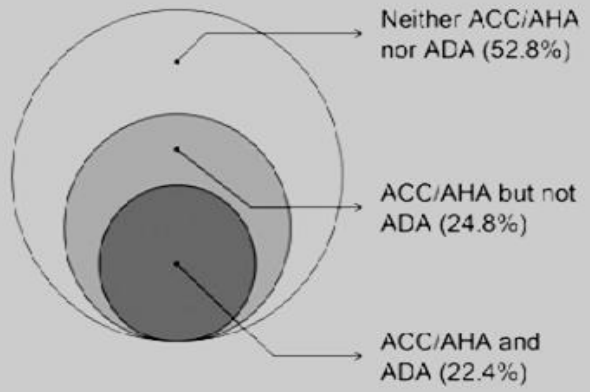


Summary statistics:

Neither ACC/AHA nor ADA:	23.9%
ADA, overall:	66.3%
ACC/AHA, overall:	77.1% *(66.3%+10.8%=77.1%)*
Agreement between ACC/AHA and ADA:	89.2% *(23.9%+66.3%=89.2%)*

Those recommended for Rx

Recommended antihypertensive medication initiation (among those not taking medication)

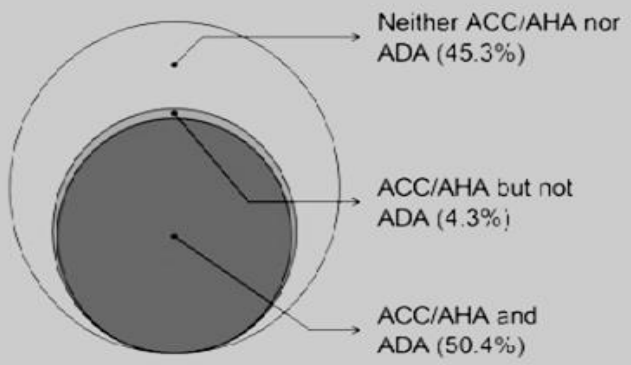


Summary statistics:

Neither ACC/AHA nor ADA:	52.8%
ADA, overall:	22.4%
ACC/AHA, overall:	47.2% *(22.4%+24.8%=47.2%)*
Agreement between ACC/AHA and ADA:	75.2% *(52.8%+22.4%=75.2%)*

Above Goal need Rx

Above goal BP (among those taking medication)



Summary statistics:

Neither ACC/AHA nor ADA:	45.3%
ADA, overall:	50.4%
ACC/AHA, overall:	54.7% *(50.4%+4.3%=54.7%)*
Agreement between ACC/AHA and ADA:	95.7% *(45.3%+50.4%=95.7%)*

Muntner P et.al. Diabetes Care 2018;41:2322-2329

Age-Related Issues

COR	LOE	Recommendations for Treatment of Hypertension in Older Persons
I	A	**Treatment of hypertension with a SBP treatment goal of less than 130 mm Hg is recommended for noninstitutionalized ambulatory community-dwelling adults (≥65 years of age) with an average SBP of 130 mm Hg or higher.**
IIa	C-EO	For older adults (≥65 years of age) with hypertension and a high burden of comorbidity and limited life expectancy, 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 drugs.

Whelton, Paul K., et al. *Journal of the American College of Cardiology* 71.19 (2018):

ESH Overall Guidance

Office BP treatment target range

Age group	Office SBP treatment ranges (mmHg)					Office DBP treatment target range (mmHg)
	HTN	+Diabetes	+CKD	+CAD		+Stroke/TIA
18-65 y	Target to 130 *Or lower if tolerated* Not <120	Target to 130 *Or lower if tolerated* Not <120	Target to <140 to 130 *if tolerated* Not <120	Target to 130 *Or lower if tolerated* Not <120	Target to 130 *Or lower if tolerated* Not <120	70-79
65-79 y	Target 130-139 *If tolerated*	Target 130-139 *If tolerated*	Target 130-139 *If tolerated*	Target 130-139 *If tolerated*	Target 130-139 *If tolerated*	70-79
≥ 80 y	Target 130-139 *If tolerated*	Target 130-139 *If tolerated*	Target 130-139 *If tolerated*	Target 130-139 *If tolerated*	Target 130-139 *If tolerated*	70-79
Office DBP treatment target range (mmHg)	70-79	70-79	70-79	70-79	70-79	

Ramzy, D. I (ESC-ESH Guidelines 2018)." *European Society of Cardiology Journals* 17 (2019).

COMPARISON OF AMERICAN VS. EUROPEAN GUIDELINES: SIMILARITIES

ACC/AHA BP 2017

- More emphasis on **home BP** and patient empowerment
- **Single pill combination** in those 20/10 mmHg above goal
- More attention to detail of **BP measurement**
- Focus on improving **adherence**

ESC/ESH BP 2018

- Wider use of **home BP** monitoring to confirm diagnosis
- Initial **single pill combination** as initial therapy
- More attention to detail of **BP measurement**
- Detection of poor **adherence**

COMPARISON OF AMERICAN VS. EUROPEAN GUIDELINES: DIFFERENCES

- **ESC/ESH BP 2018**

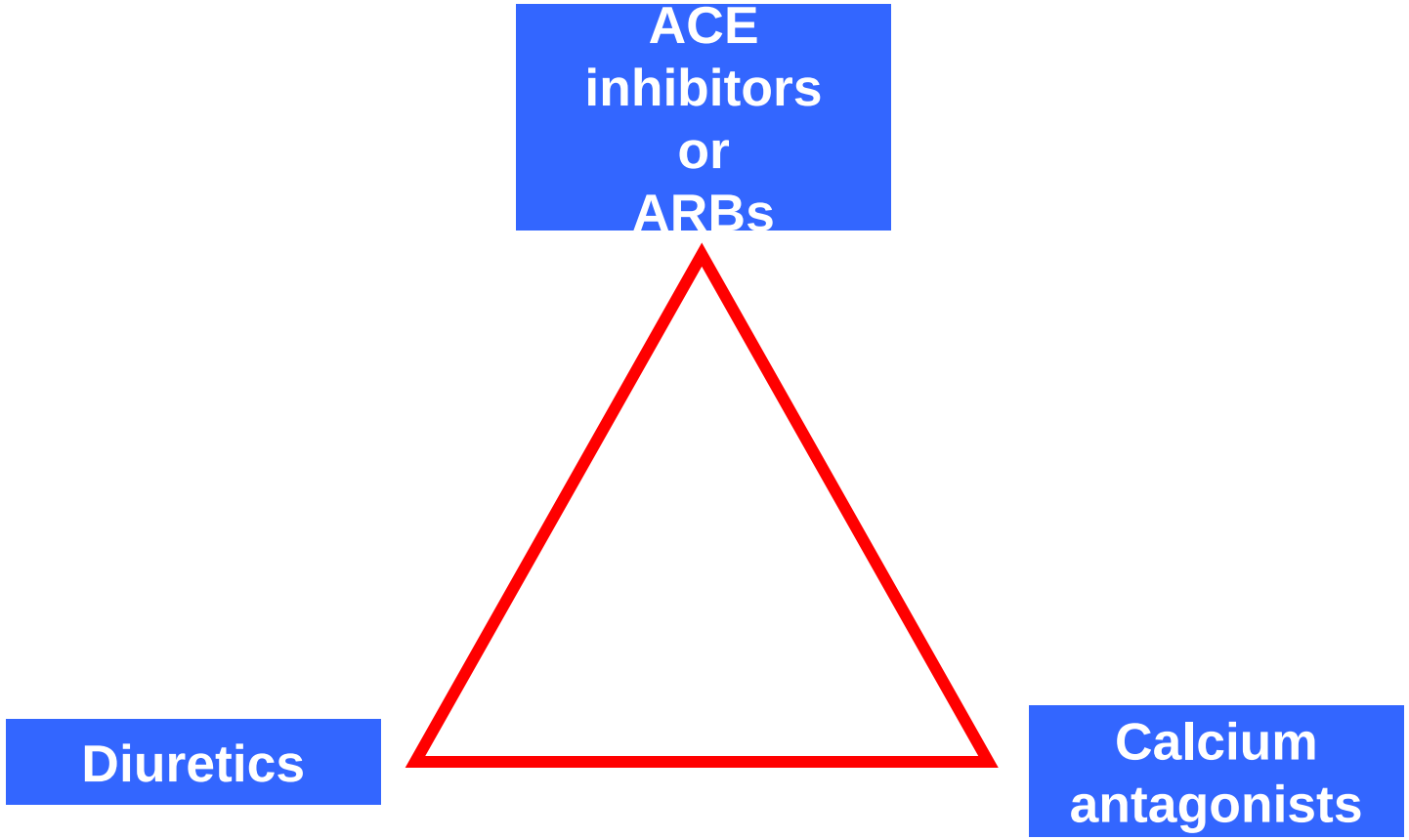
- No specific focus on >10%-10 year **CV risk**
- No specific attention to **prevention** as BP approaches 130/80 mmHg
- Much less attention to **specific ethnic/racial** groups
- **Retained definition of hypertension** >140/90 mmHg and encouraged patient discussion and education to get <130/80 mmHg in those who require it by the evidence
- **Limits on BP reduction** –NOT below 120/70 mmHg

Clinician's Sequential Flow Chart for the Management of Hypertension
Measure office BP accurately
Detect white coat hypertension or masked hypertension by using ABPM and HBPM
Evaluate for secondary hypertension
Identify target organ damage
Introduce lifestyle interventions
Identify and discuss treatment goals
Use ASCVD risk estimation to guide BP threshold for drug therapy
Align treatment options with comorbidities
Account for age, race, ethnicity, sex, and special circumstances in antihypertensive treatment
Initiate antihypertensive pharmacological therapy
Insure appropriate follow-up
Use team-based care
Connect patient to clinician via telehealth
Detect and reverse nonadherence
Detect white coat effect or masked uncontrolled hypertension
Use health information technology for remote monitoring and self-monitoring of BP

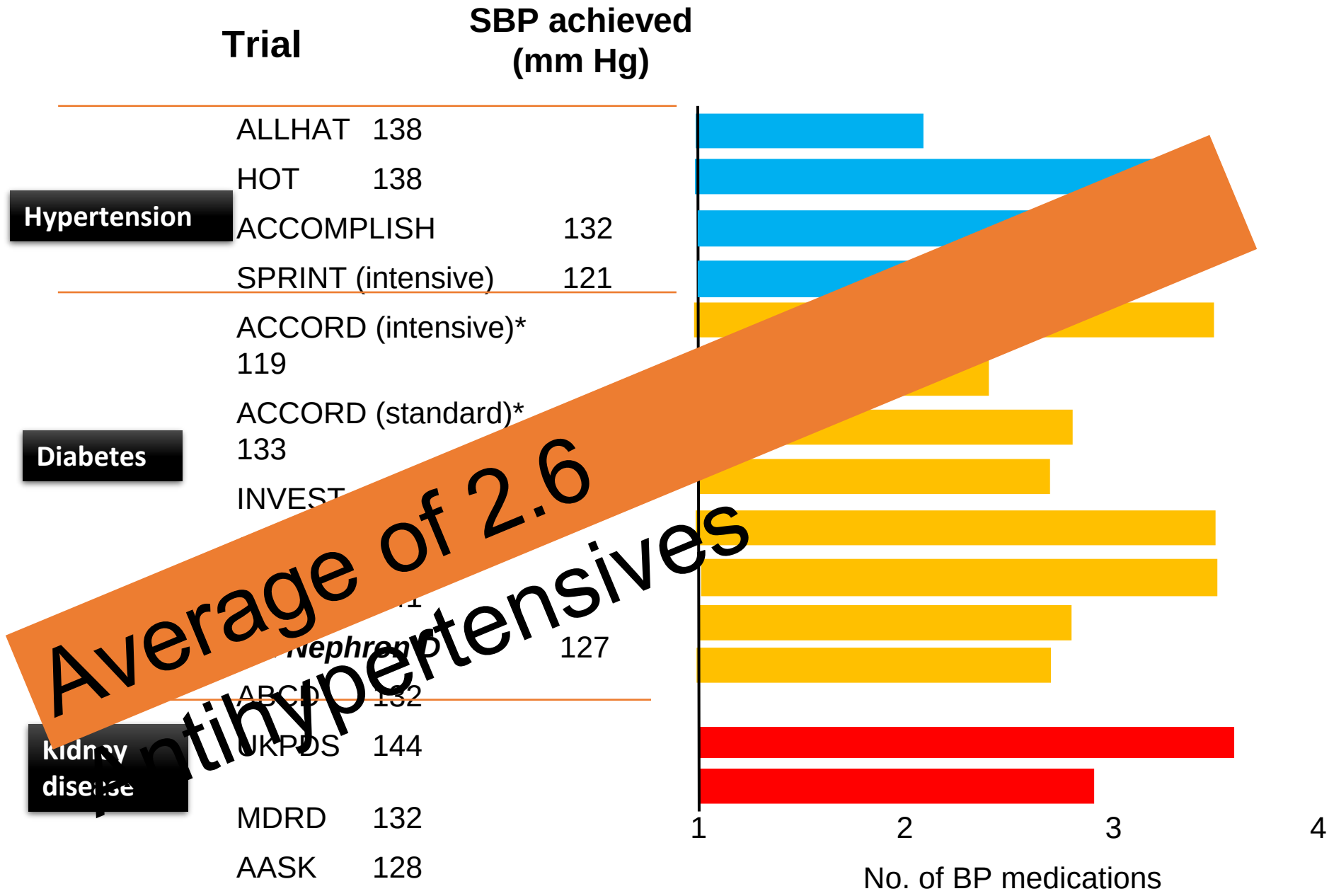
Whelton, Paul K., et al. *Journal of the American College of Cardiology* 71.19 (2018):

ASCVD indicates atherosclerotic cardiovascular disease; BP, blood pressure; CVD, cardiovascular disease; and SBP, systolic blood pressure.

INITIAL COMBINATIONS OF MEDICATIONS*

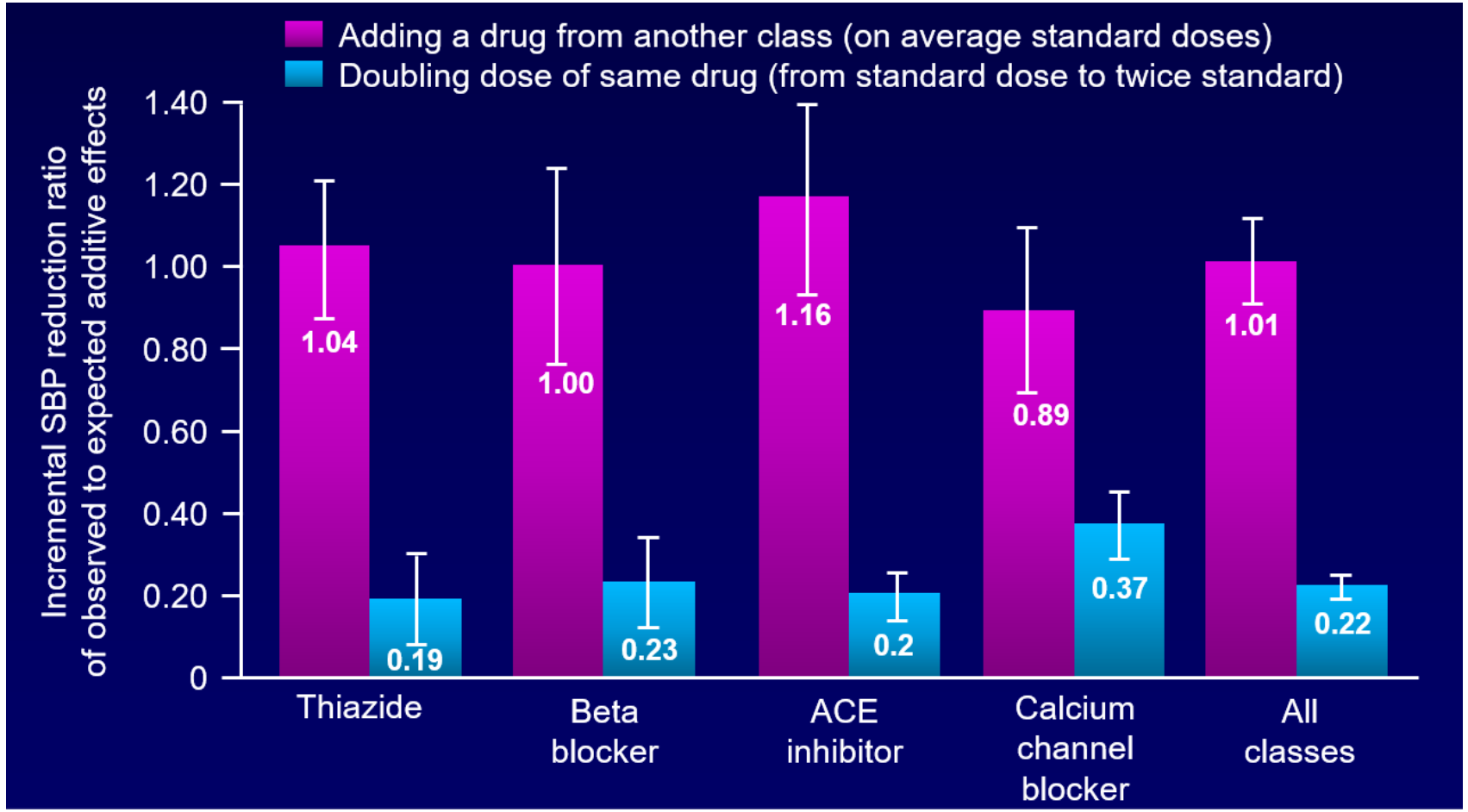


*** Compelling indications may modify this.**



Bold italic studies-both diabetes and kidney disease outcomes

RATIO OF OBSERVED TO EXPECTED INCREMENTAL BP-LOWERING EFFECTS OF ADDING A DRUG OR DOUBLING THE DOSE ACCORDING TO DRUG CLASS



Wald DS et al. *Am J Med.* 2009;122:290-300.

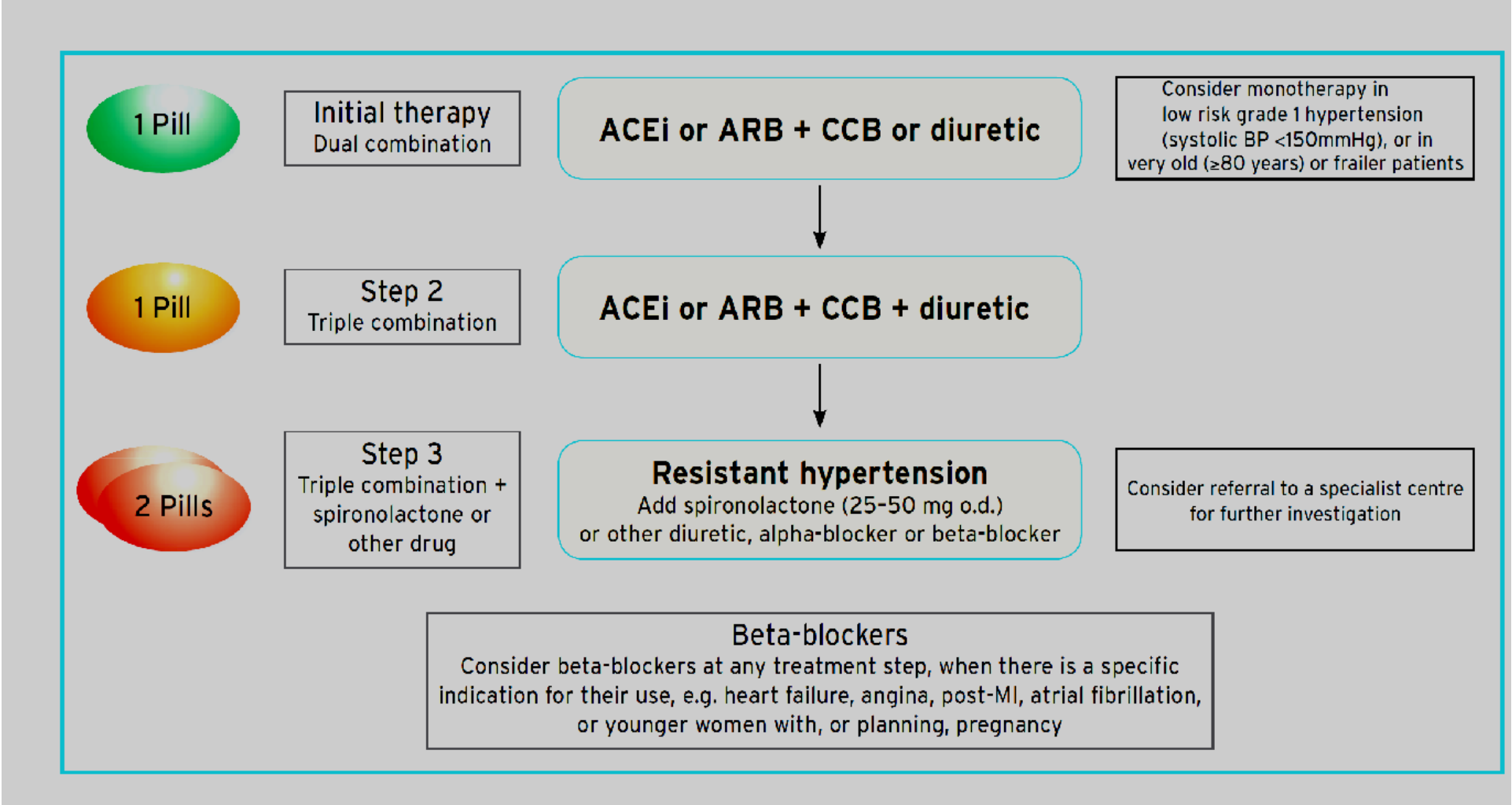
American Society of Hypertension Evidenced based fixed dose antihypertensive combinations

Preferred
· **ACE inhibitor/diuretic***   · **ARB/diuretic***   · **ACE inhibitor/CCB***   · **ARB/CCB***
Acceptable
· Beta blocker/diuretic*   · CCB (dihydropyridine)/β-blocker   · CCB/diuretic   · Renin inhibitor/diuretic*   · Renin inhibitor/ARB*   · Thiazide diuretics/K+ sparing diuretics*
Less Effective
· ACE inhibitor/ARB   · ACE inhibitor/β-blocker   · ARB/β-blocker   · CCB (nondihydropyridine)/β-blocker   · Centrally acting agent/β-blocker

*** SPC avaialble in US**

Gradman AH, et.al… and Bakris GL J Clin Hypertens (Greenwich) 2011;13:146-54.

ESC/ESH 2018



Williams B et.al Eur Heart J 2018

TRIALS OF URINE METABOLITES ASSESSING ADHERENCE IN HYPERTENSION

- Jung O et.al. Journal of Hypertension. 2[illegible]1(4):766-774
- Tomaszewski, M et.al. Hear[illegible],100:855–861

Both studies show about a 45% adherence with BP lowering meds

Journal of the American Society of Hypertension 11(2) (2017) 122–129

Review Article

Sleep, insomnia, and hypertension: current findings and future directions

S. Justin Thomas, PhD[a,*] and David Calhoun, MD[b]

[a]*Department of Epidemiology, University of Alabama at Birmingham, Birmingham, AL, USA; and*
[b]*Department of Medicine, Division of Cardiovascular Disease, University of Alabama at Birmingham, Birmingham, AL, USA*

Manuscript received October 10, 2016 and accepted November 26, 2016

Reported associations between insomnia and hypertension have been inconsistent.

Insomnia combined with a short sleep duration (<5 hours, but not > 5 hours) is associated with a significantly increased risk of hypertension.

Nurses Health Study

71,617 women 45-65 years

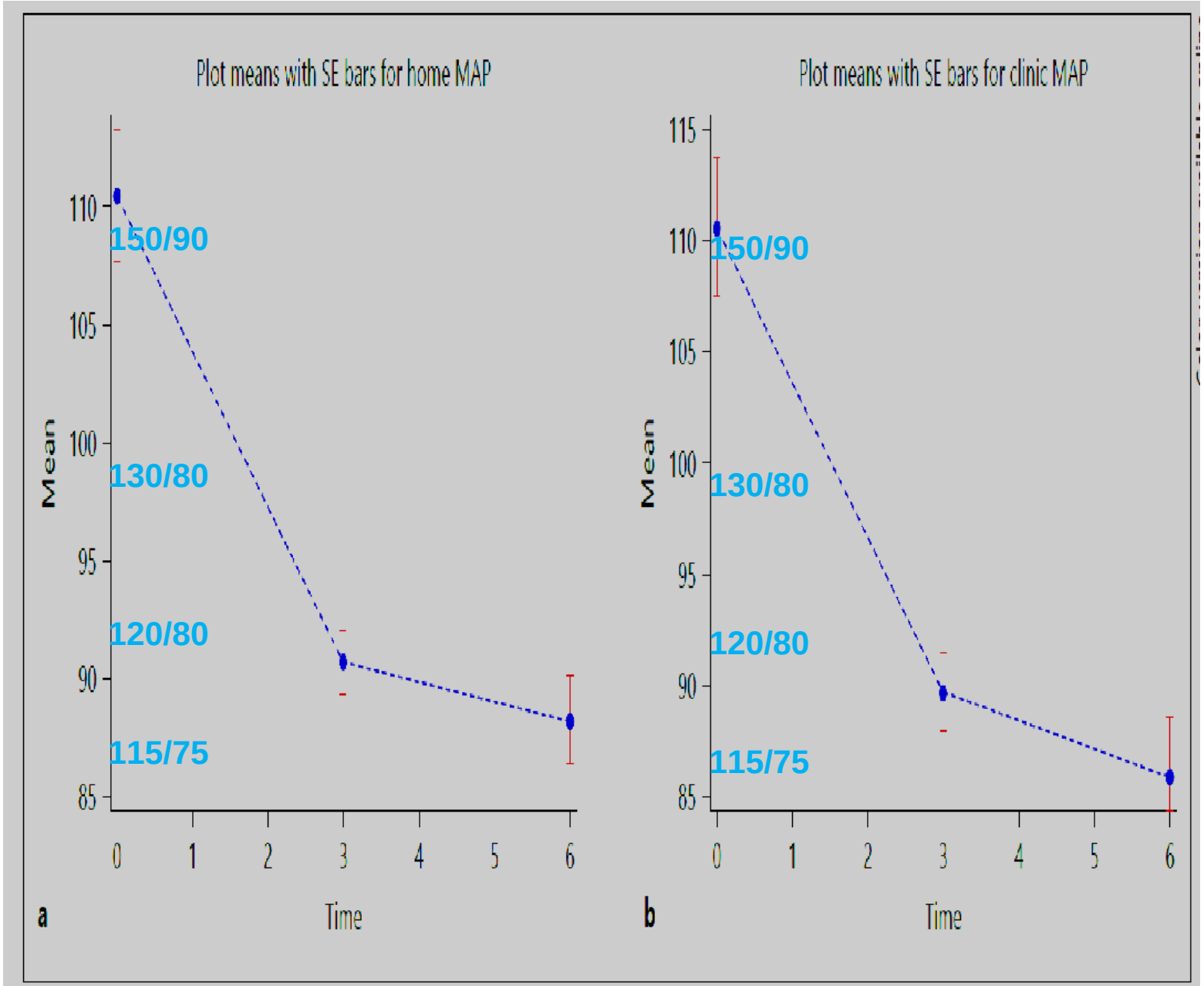
10-year follow-up of Incident CHD

Sleep Duration	Relative Risk	Confidence Interval
5 hours	1.82	1.34 – 2.41
6 hours	1.30	1.08 – 1.57
7 hours	1.06	0.89 – 1.26
8 hours	1	1

(Ayas et al 2003)

BP Change after Months of Restored Sleep Duration

Variables	Total (n = 30)
Gender n (%)	
Male	13 (43)
Female	17 (57)
Age, years, n (%)	
30–49	4 (13)
50–70	11 (37)
>70	15 (50)
Race, n (%)	
African American	17 (57)
White	13 (43)
Diabetes mellitus, n (%)	12 (40)
Hyperlipidemia, n (%)	17 (57)
BMI, kg/m^2, mean ± SD	32±8
OSA, n (%)*	16 (53)
Baseline BP, mm Hg, mean ± SD**	
Clinic	156±21.27/88±17
Home	159±17.3/86±16.6
eGFR, mL/min, mean ± SD	43±16
Baseline eGFR, mL/min, n (%)	
15–60	27 (90)
<15	3 (10)
Sleep duration, h, n (%)	
>6	0
4–6	15 (50)
<4	15 (50)
Sleep variables, n (%)	
Inability to initiate sleep	18 (60)
Inability to stay asleep	23 (77)



Ali W et.al. Am J Nephrology 2020;51:249-254

MANAGEMENT OF RESISTANT HYPERTENSION

Exclude other causes of hypertension, including secondary causes, white-coat effect and medication nonadherence

+

Ensure low sodium diet (<2400 mg/day)
Maximize lifestyle interventions
- ≥ 6 hrs uninterrupted sleep
- Overall dietary pattern
-Weight loss
-Exercise

+

Optimize 3-drug regimen
Ensure adherence to 3 of different classes (RAS blocker, CCB, diuretic) at maximum or maximally tolerated doses. Diuretic type must be appropriate for kidney function*

BP not at target

Step 2

Substitute optimally dosed thiazide-like diuretic: i.e. chlorthalidone or indapamide* for the prior diuretic

BP not at target

Step 3

Add mineralocorticoid receptor antagonist (MRA): spironolactone or eplerenone**

BP still not at target

Step 4

Note: Steps 4-6 are suggestions on the basis of expert opinion only and these steps should be individualized.

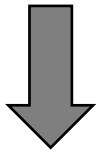
Check Heart Rate: Unless <70 beats/ min, **add beta blocker** (eg. metoprolol succinate, bisoprolol) or combined alpha-beta blocker (eg. labetalol, carvedilol). If beta blocker contradicted, consider central alpha-agonist i.e. clonidine patch weekly or guanfacine at bedtime). If these are not tolerated, consider once daily diltiazem.

BP still not at target

Step 5

Add hydralazine* ** 25mg three times daily and titrate upward to max dose; in patients with congestive heart failure with reduced ejection fraction, hydralazine should be administered on a background isosorbide mononitrate 30 mg daily (max. dose 90 mg daily)

BP still not at target



Step 6

Substitute minoxidil**** 2.5mg two to three times daily for hydralazine and titrate upward. If BP still not at target, consider referral to a hypertension specialist and/or for ongoing experimental studies- www.clinicaltrials.gov

- * These diuretics maintain efficacy down to estimated glomerular filtrations rates of 30ml/min/1/73m^2
- ** Use caution if eGFR<30 ml/min/1.73m2
- *** Require concomitant use of beta blocker and a diuretic
- **** Require the concomitant use of a beta blocker and a loop diuretic

Carey RM, et.al. Hypertension 2018;72:e53-e90.