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Founding Member, Mass General Brigham

Hypertension Evaluation and Management

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Co-Director of Diabetes Comorbidities Course @ HMS

- Clinical focus: Diabetic Kidney Disease
- Research focus: Medical Education and Implementation Science of Disease Modifying Therapies

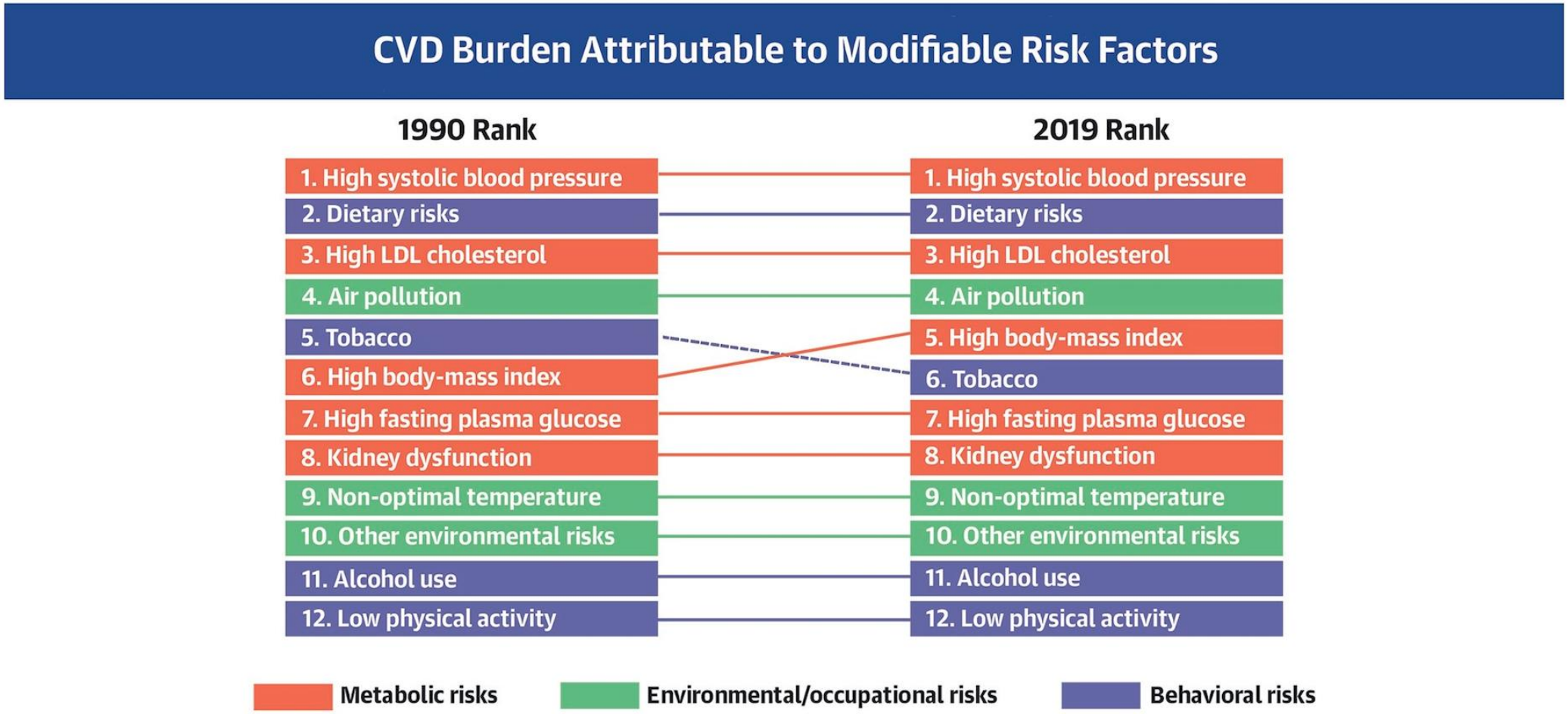
DISCLOSURES

None

OBJECTIVES

- Understand blood pressure targets and review practical monitoring guidelines
- Review latest guidelines and landmark studies on hypertension care
- Manage hypertension with focus on disease modifying therapies

Hypertension #1 for CVD Burden



Roth, G, Mensah, G, Johnson, C. et al. Global Burden of Cardiovascular Diseases and Risk Factors, 1990–2019: Update From the GBD 2019 Study. JACC. 2020 Dec, 76 (25) 2982–3021

15 million US adults have a 10-year risk for Heart Failure **greater than 10%** using the PREVENT equations

Table. Differences in 10-Year Risk Category Classification Comparing HF and ASCVD Risk

Risk Category	Persons in 10-y HF Risk Category (95% CI), *n (millions)**			
	Low Risk (<10.0%)	Intermediate Risk (10.0%–19.9%)	High Risk (≥20.0%)	Total†
Overall	128.22 (117.19–139.25)	12.20 (10.50–13.90)	2.79 (2.20–3.38)	143.21 (131.14–155.27)
By ASCVD 10-y risk category‡				
Low risk (<10.0%)§	126.97 (116.09–137.85)	4.22 (3.44–5.00)‖	0.06 (0.00–0.13)‖	131.25 (120.25–142.24)
Intermediate risk (10.0%–19.9%)	1.25 (0.79–1.70)¶	7.95 (6.40–9.50)	2.29 (1.89–2.69)‖	11.48 (9.63–13.33)
High risk (≥20%)	0.00 (0.00–0.00)¶	0.04 (0.00–0.10)¶	0.44 (0.13–0.75)	0.48 (0.17–0.79)

ASCVD = atherosclerotic cardiovascular disease; HF = heart failure.

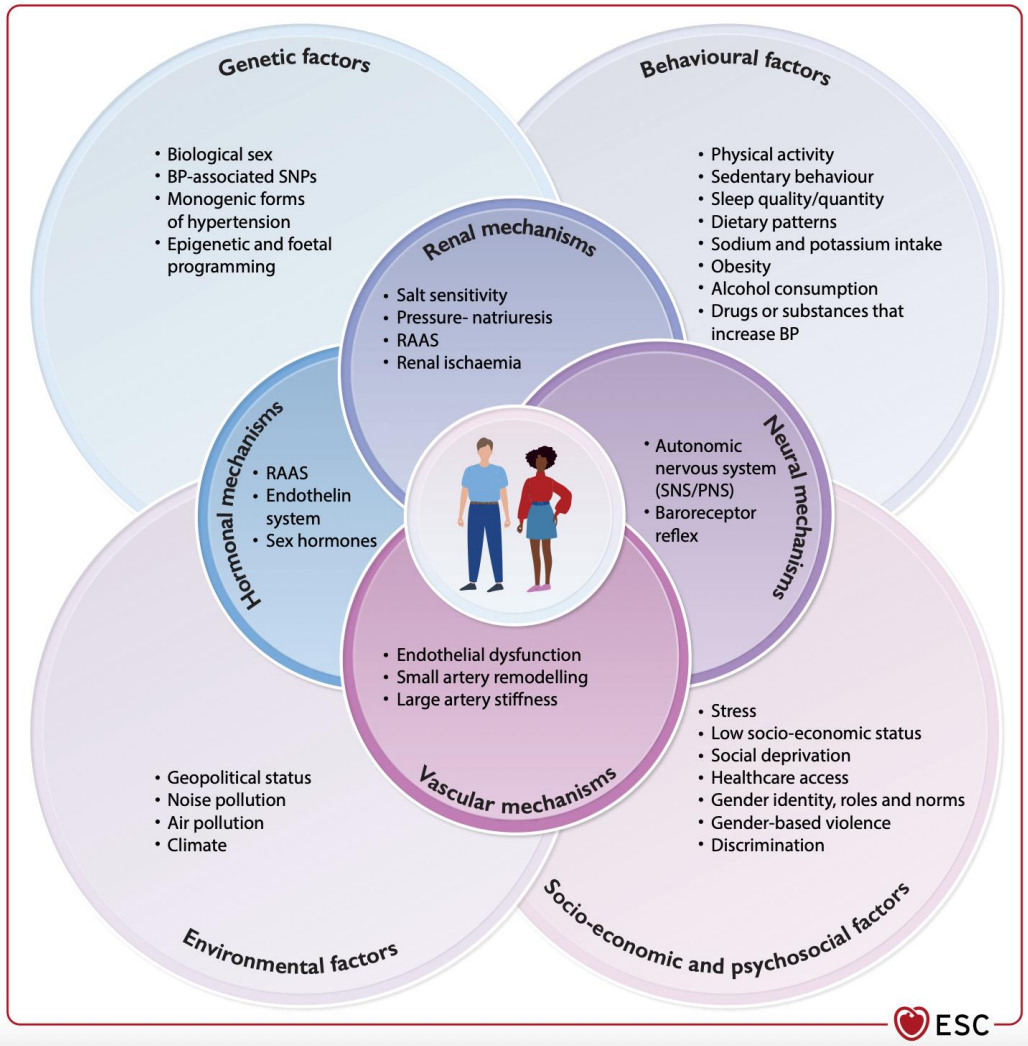
The American Heart Association PREVENT™ Online Calculator

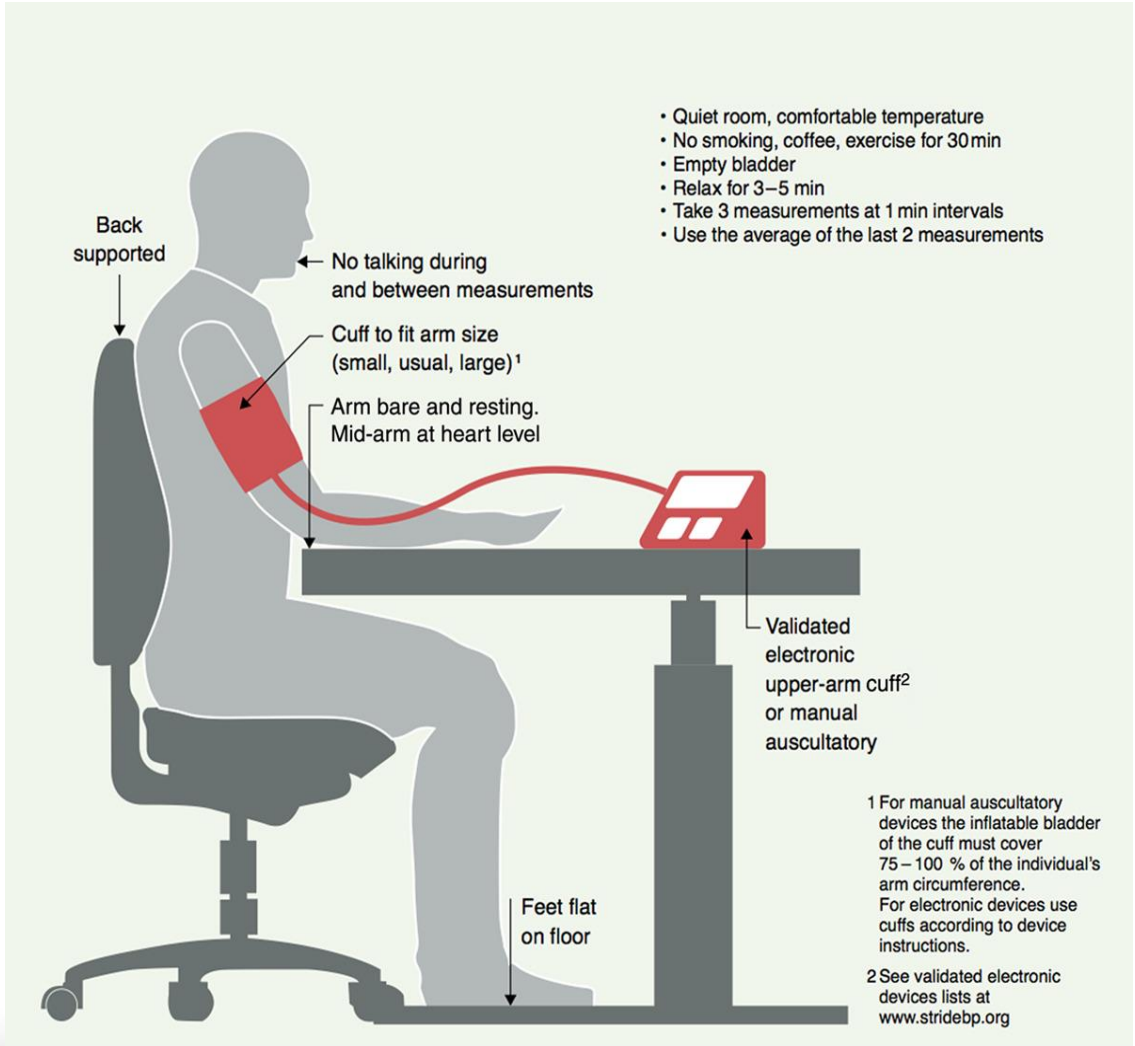
Welcome to the American Heart Association **Predicting Risk of cardiovascular disease EVENTs** (PREVENT™). This app should be used for primary prevention patients (those without atherosclerotic cardiovascular disease or heart failure) only.

- ❑ Sex
- ❑ Age (30-79)
- ❑ Total Cholesterol
- ❑ HDL Cholesterol
- ❑ SBP
- ❑ BMI
- ❑ eGFR
- ❑ Diabetes?
- ❑ Current Smoking?
- ❑ Anti-HTN meds?
- ❑ Lipid lowering meds?
- ❑ UACR
- ❑ Hgb A1c
- ❑ Zip Code

Sussman JB, Wilson LM, Burke JF, Ziaeian B, Anderson TS. Clinical Characteristics and Current Management of U.S. Adults at Elevated Risk for Heart Failure Using the PREVENT Equations: A Cross-Sectional Analysis. Ann Intern Med. 2025 Jan;178(1):144-147.

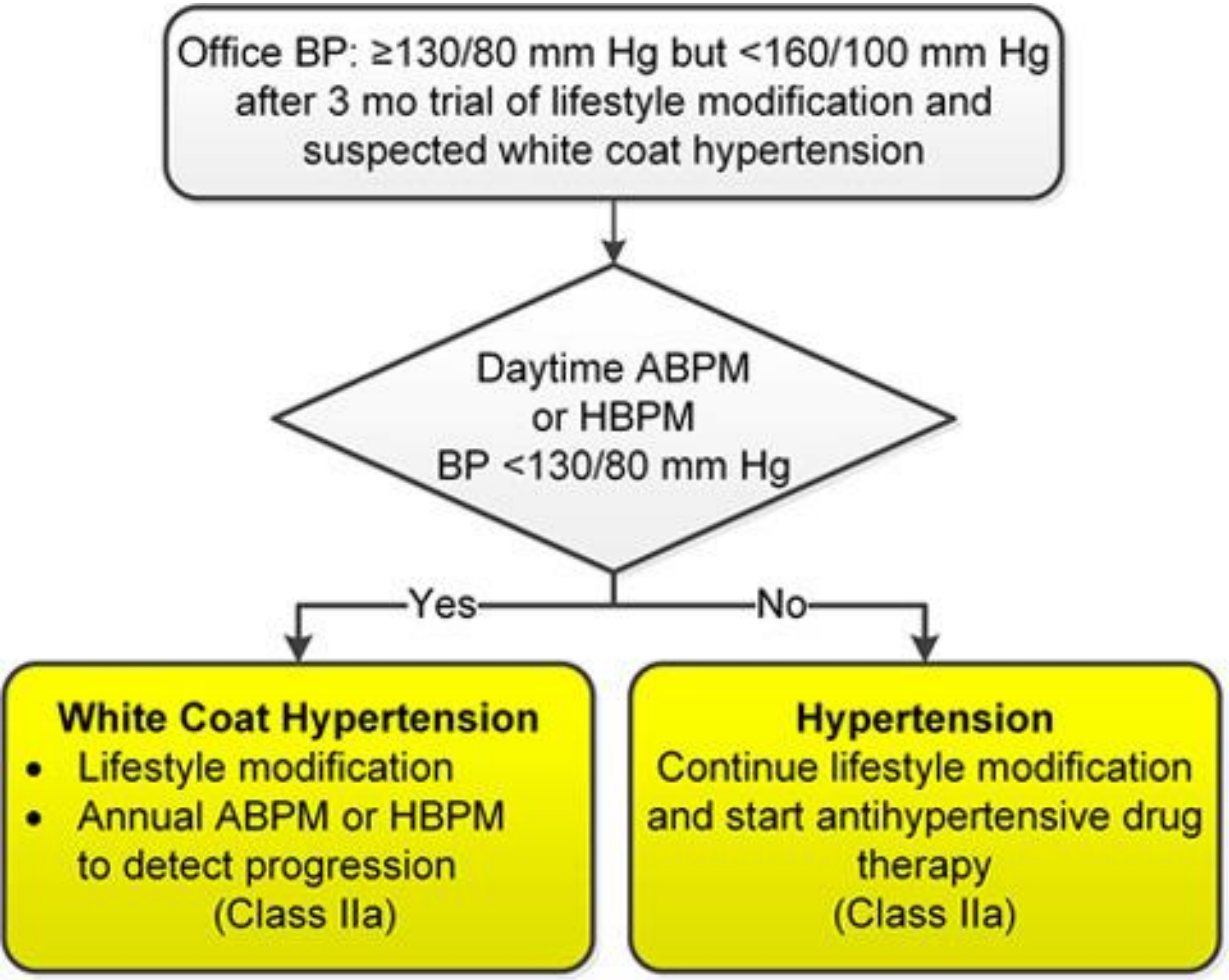
1st Step: Diagnosis

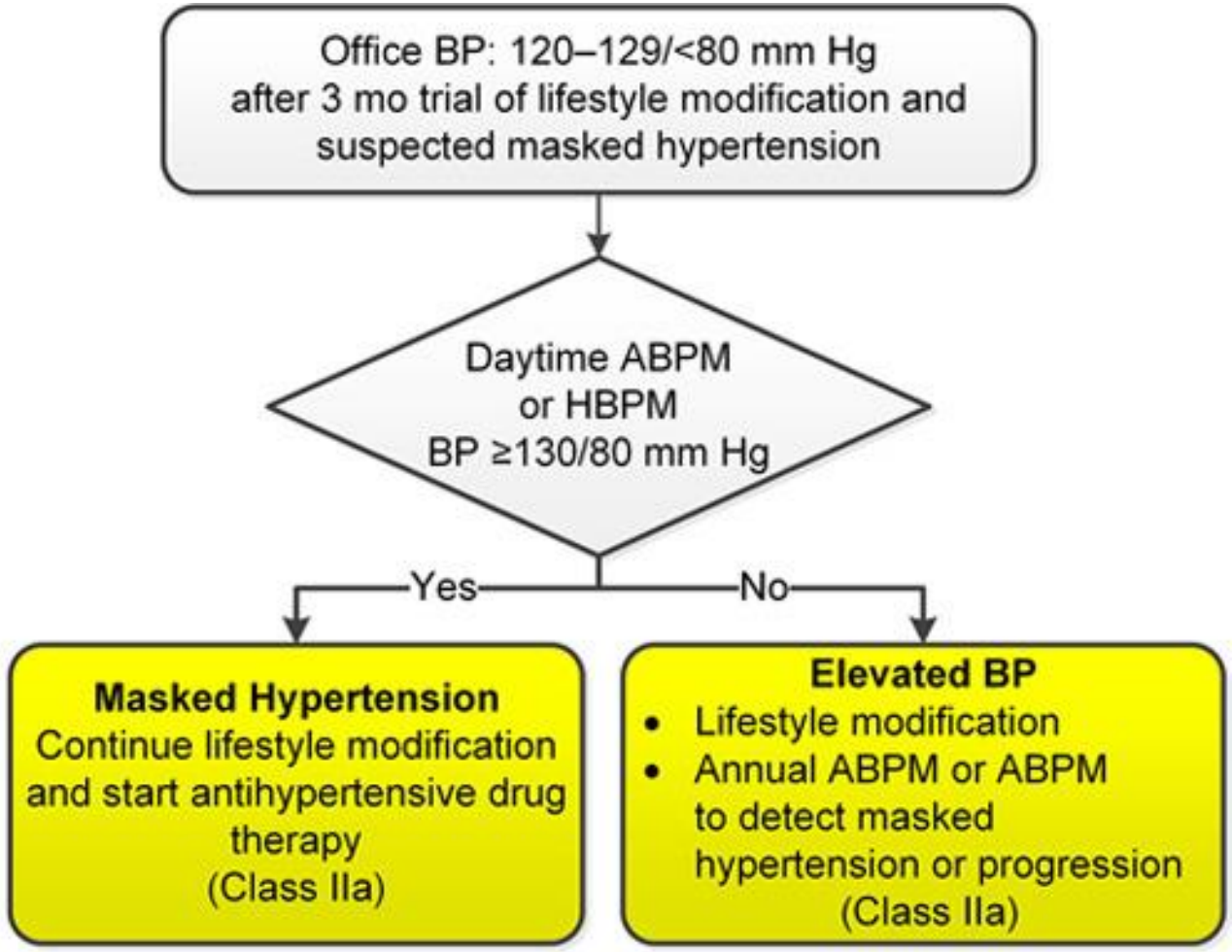




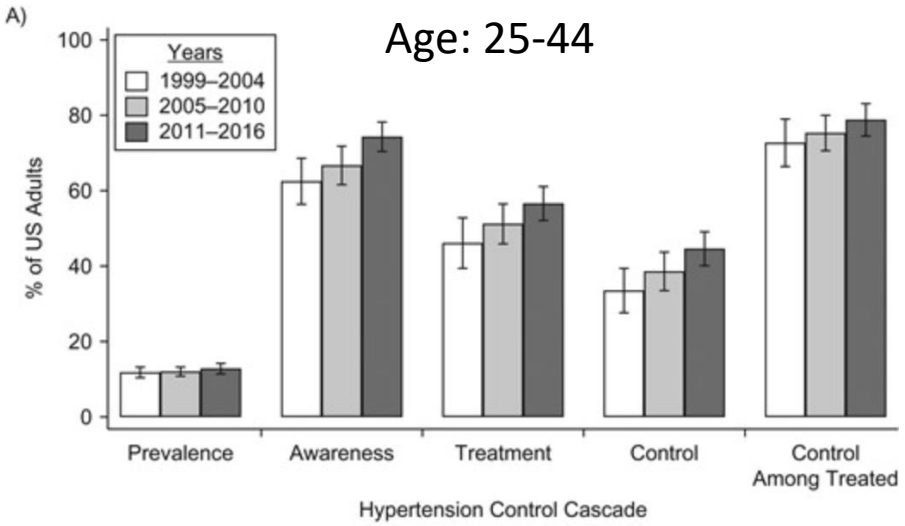
John William McEvoy, Cian P McCarthy, et.al. 2024 ESC Guidelines for the management of elevated blood pressure and hypertension: Developed by the task force on the management of elevated blood pressure and hypertension of the European Society of Cardiology (ESC) and *endorsed by the European Society of Endocrinology (ESE) and the European Stroke Organisation (ESO)*, *European Heart Journal*, Volume 45, Issue 38, 7 October 2024, Pages 3912–4018,
Thomas Unger. Hypertension. 2020 International Society of Hypertension Global Hypertension Practice Guidelines, Volume: 75, Issue: 6, Pages: 1334-1357, DOI: (10.1161/HYPERTENSIONAHA.120.15026)

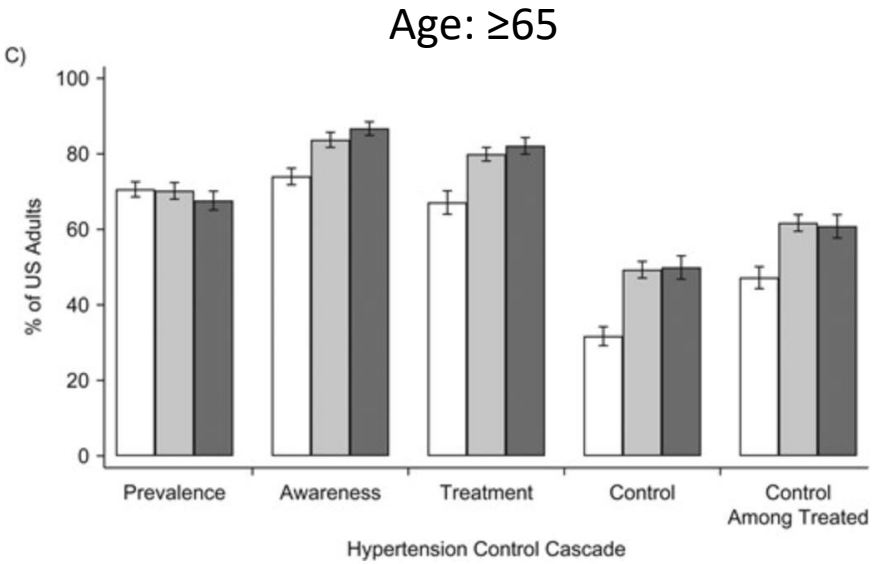
1st Step: Diagnosis

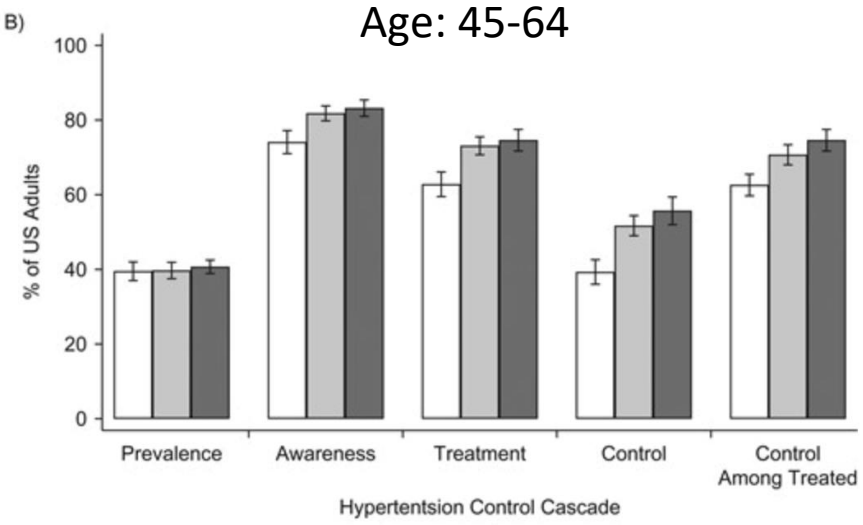




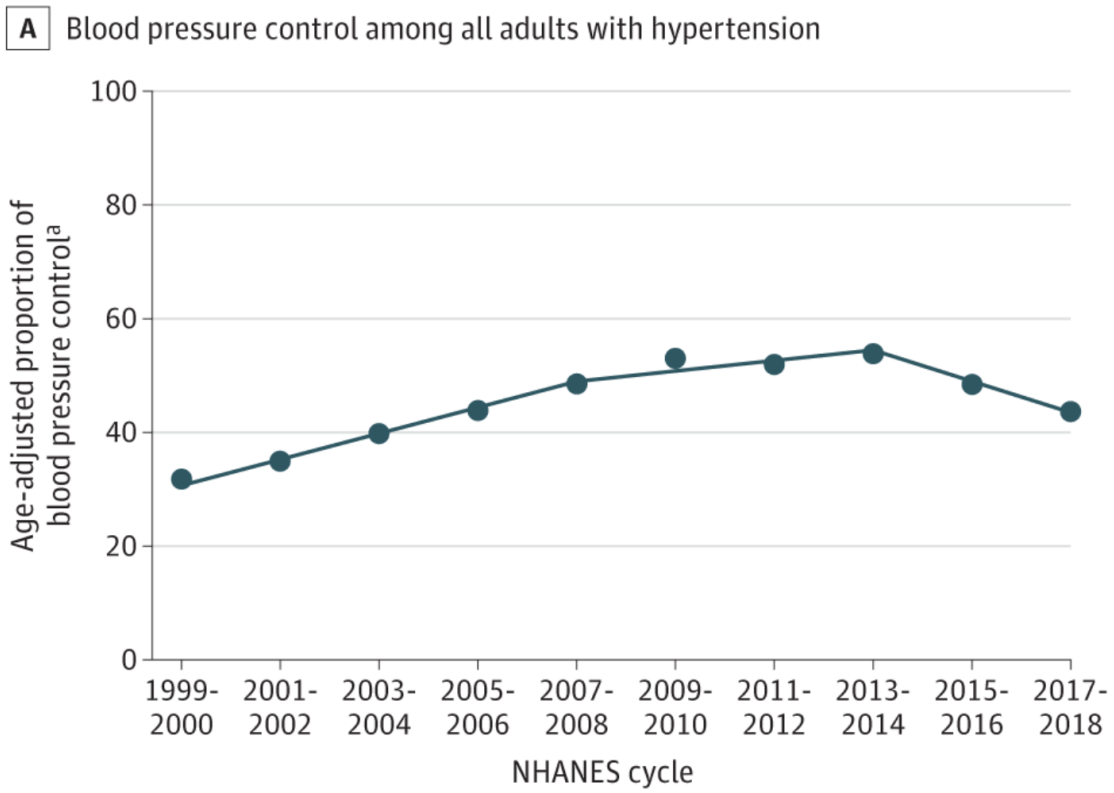
Whelton, P. K., et al. (2018). "2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines." Hypertension **71**(6): e13-e115.

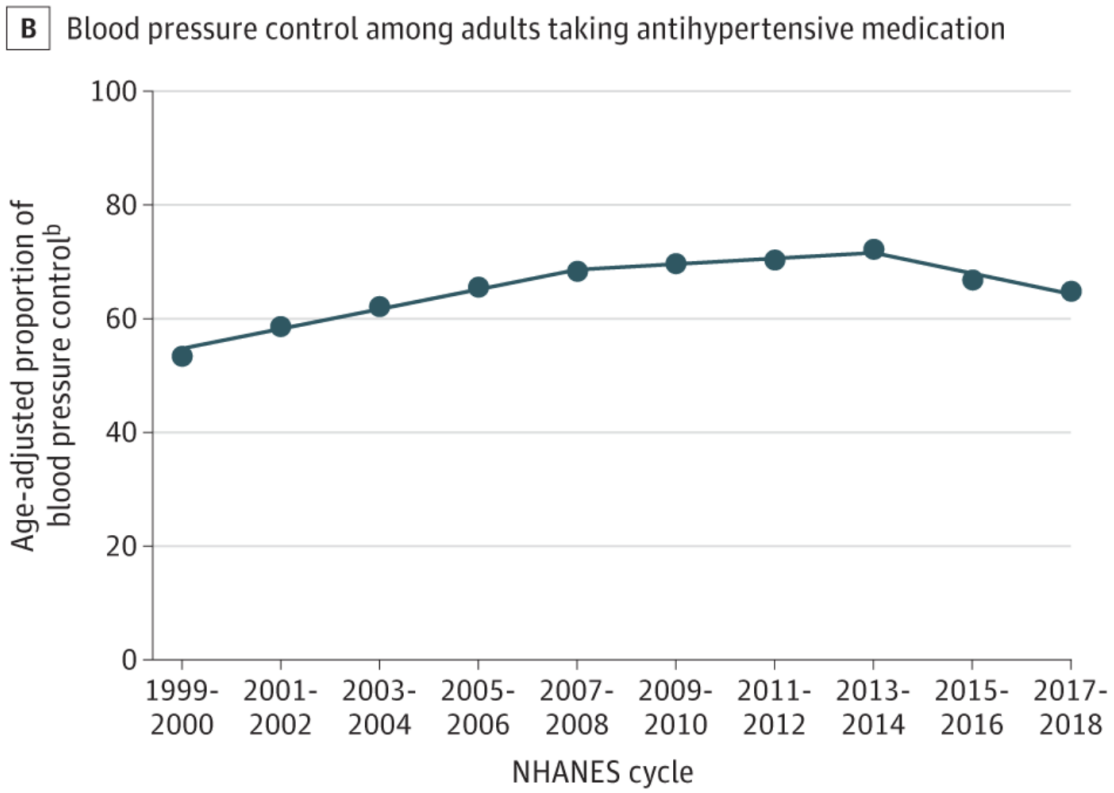

A)
Age: 25-44
Years
1999–2004
2005–2010
2011–2016
% of US Adults
100
80
60
40
20
0
Prevalence
Awareness
Treatment
Control
Control Among Treated
Hypertension Control Cascade


C)
Age: ≥65
% of US Adults
100
80
60
40
20
0
Prevalence
Awareness
Treatment
Control
Control Among Treated
Hypertension Control Cascade


B)
Age: 45-64
% of US Adults
100
80
60
40
20
0
Prevalence
Awareness
Treatment
Control
Control Among Treated
Hypertentsion Control Cascade

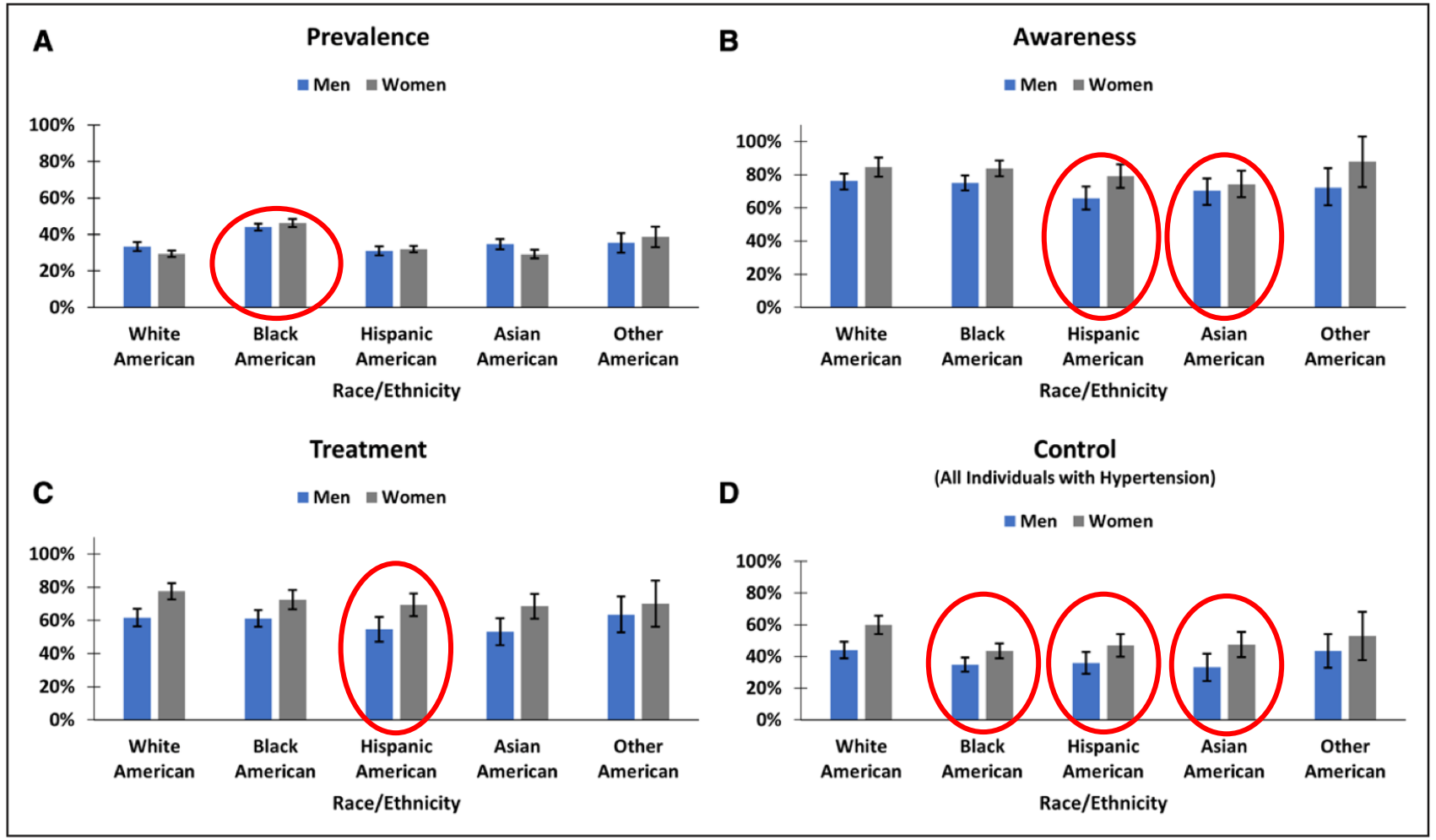
Hypertension and Drug Treatment Thresholds





Muntner P, Hardy ST, Fine LJ, Jaeger BC, Wozniak G, Levitan EB, Colantonio LD. Trends in Blood Pressure Control Among US Adults With Hypertension, 1999-2000 to 2017-2018. JAMA. 2020 Sep 22;324(12):1190-1200.

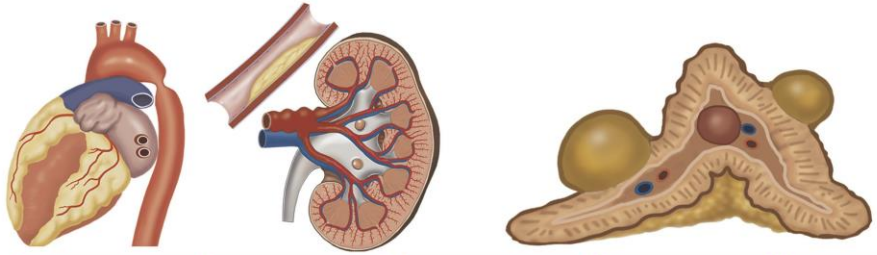
Racial/Ethnic Disparities in Hypertension Prevalence, Awareness, Treatment



Aggarwal R, Chiu N, Wadhera RK, Moran AE, Raber I, Shen C, Yeh RW, Kazi DS. Racial/Ethnic Disparities in Hypertension Prevalence, Awareness, Treatment, and Control in the United States, 2013 to 2018. Hypertension. 2021 Dec;78(6):1719-1726.

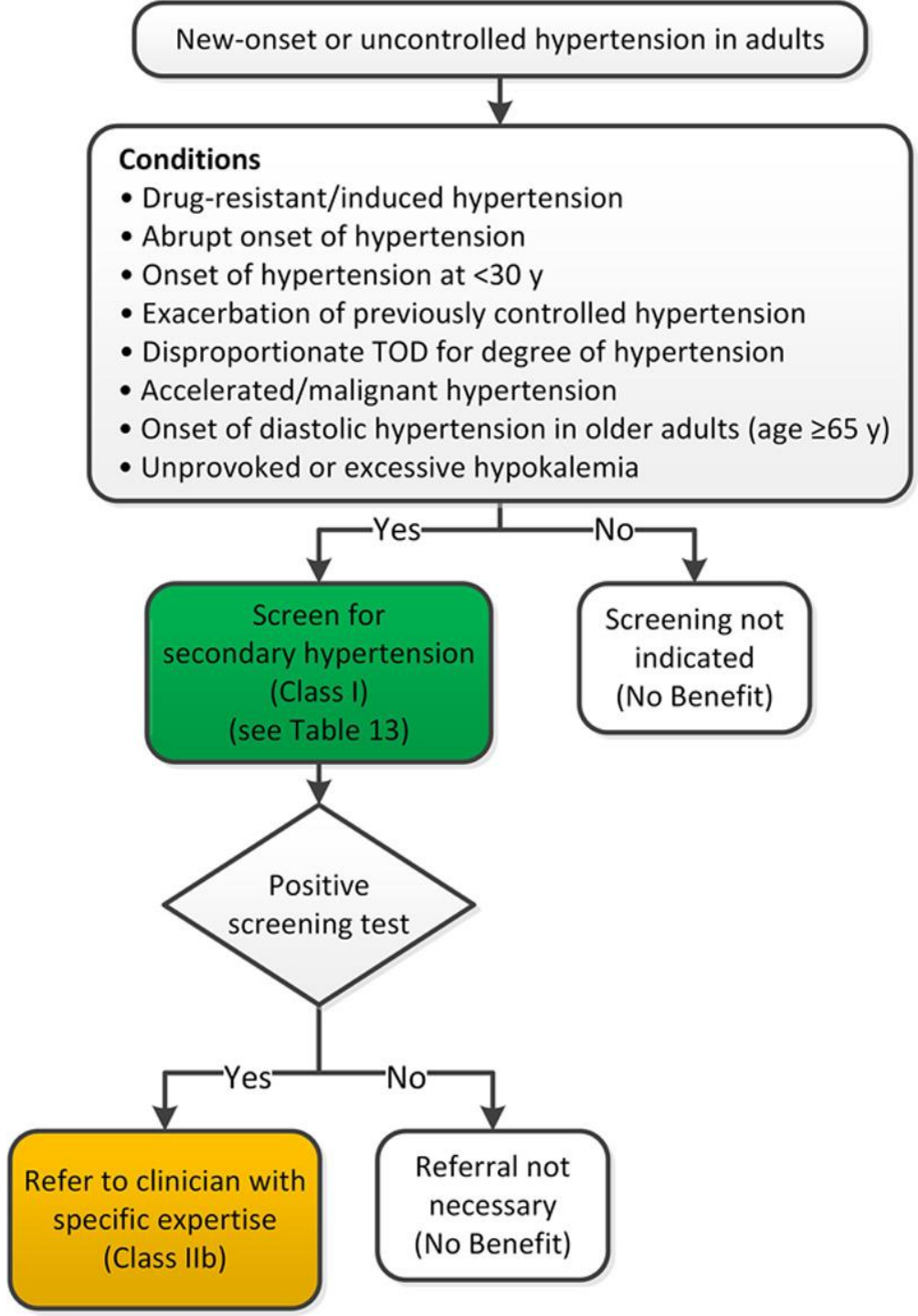
Primary or Secondary?

CENTRAL ILLUSTRATION: Cardiac Phenotypes in Secondary Hypertension



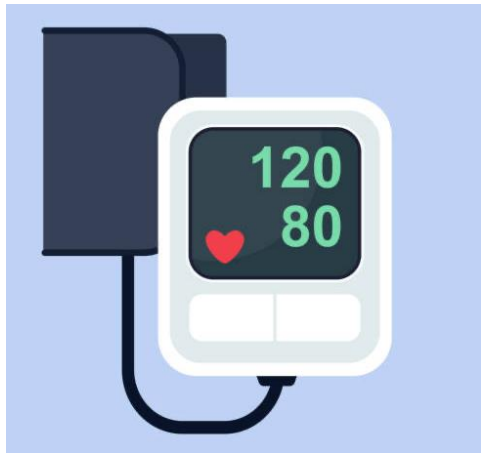
	Coartation of Aorta	Renovascular Hypertension	Primary Aldosteronism	Pheochromocytoma /Paraganglioma	Cushing Syndrome
	• Vasculopathy • Sympathetic activity	• Angiotensin II • Aldosterone • Sodium/volume retention	• Aldosterone • Sodium retention	• Catecholamines	• Cortisol
LVH	↑↑	↑ARAS ↔FMD	↑↑	↑	↑
Diastolic Function	↓	↑ARAS ↔FMD	↓↓	↔	↓
Systolic Function	↓(advanced)	-	↓↓strain	↓↓strain	↓
In CMR	LVH, aortic dilatation	-	LVH, fibrosis, edema	fibrosis, edema	↔fibrosis
Cardiac Events	CAD, HF	ARAS: CAD, AHF FMD: SCAD	CAD, HF, AF	TTS, hypertrophic/dilated cardiomyopathy, arrhythmias, ACS, AHF	CAD

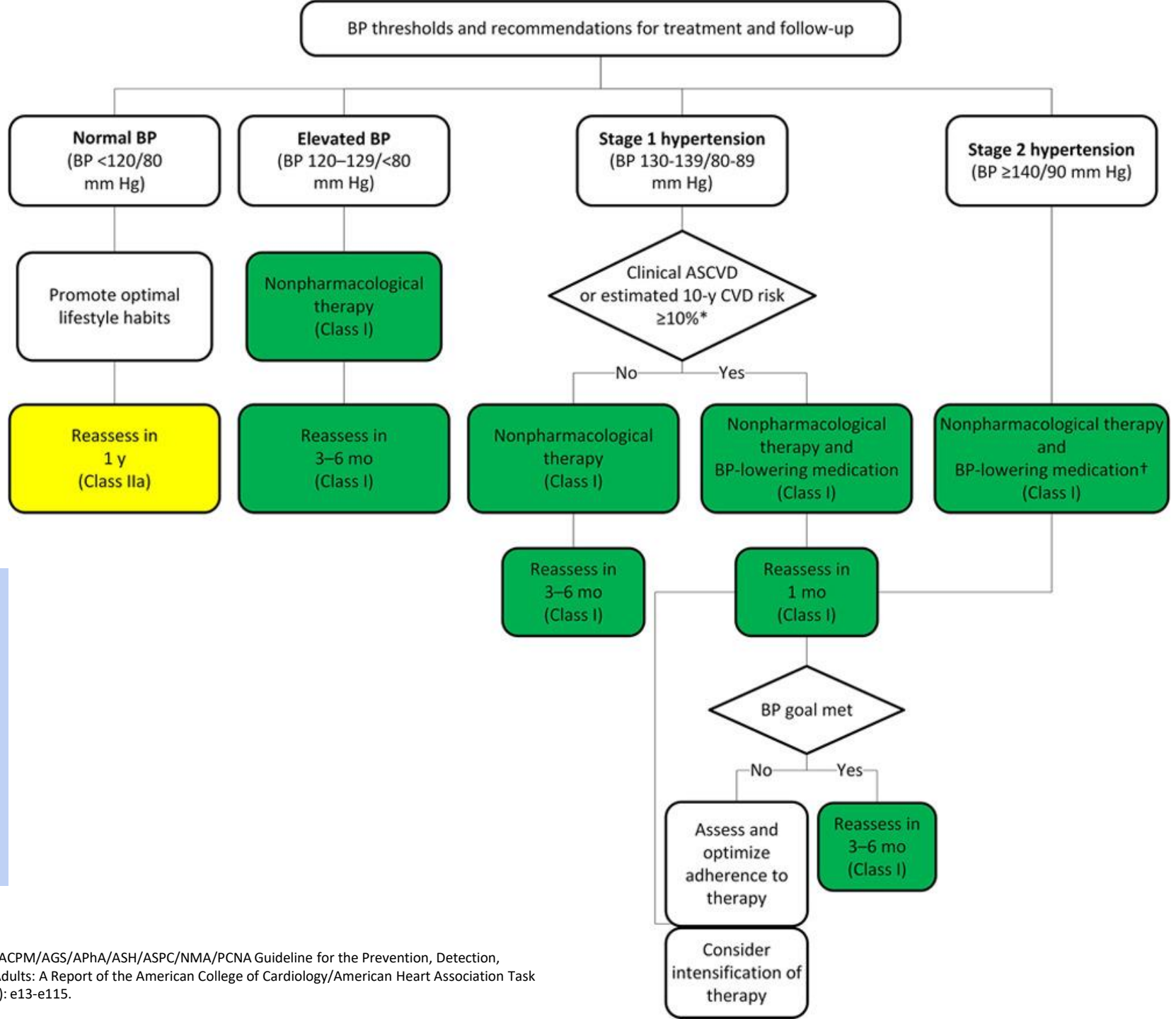
Januszewicz A, et al. J Am Coll Cardiol. 2022;80(15):1480-1497.



Whelton, P. K., et al. (2018). "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." Hypertension **71**(6): e13-e115.

Treat and Reassess

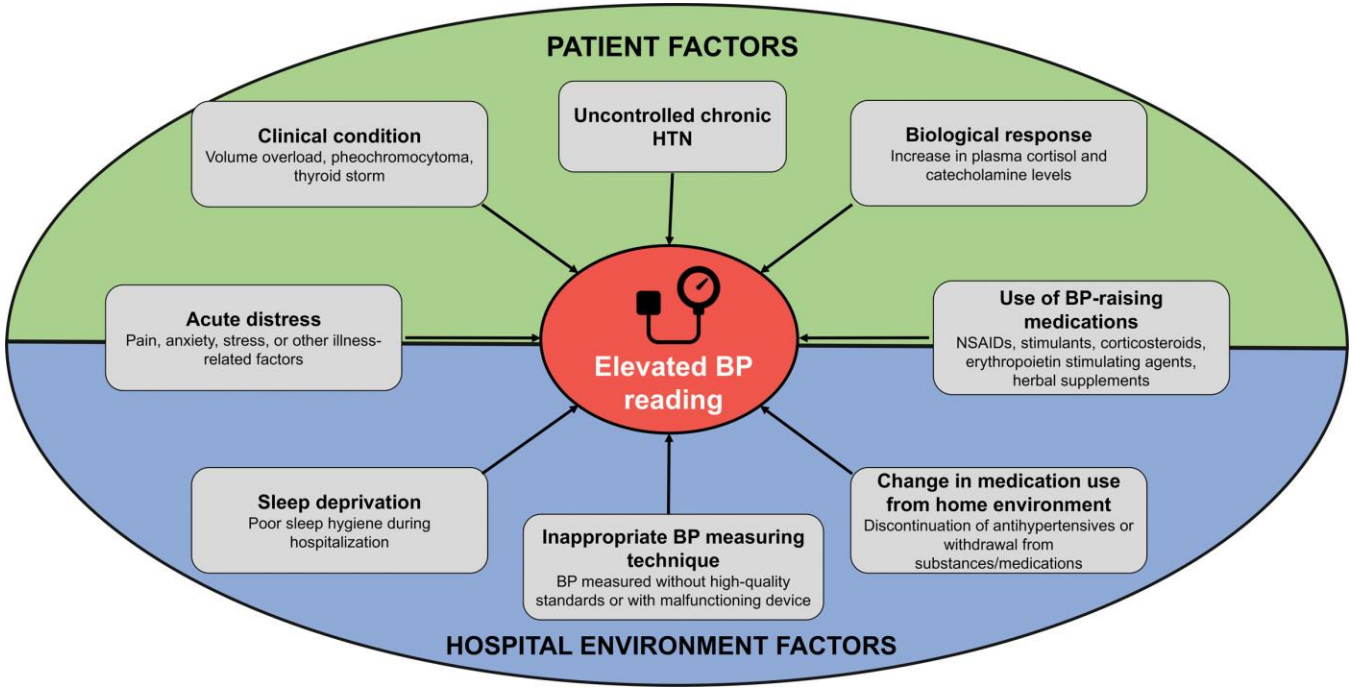


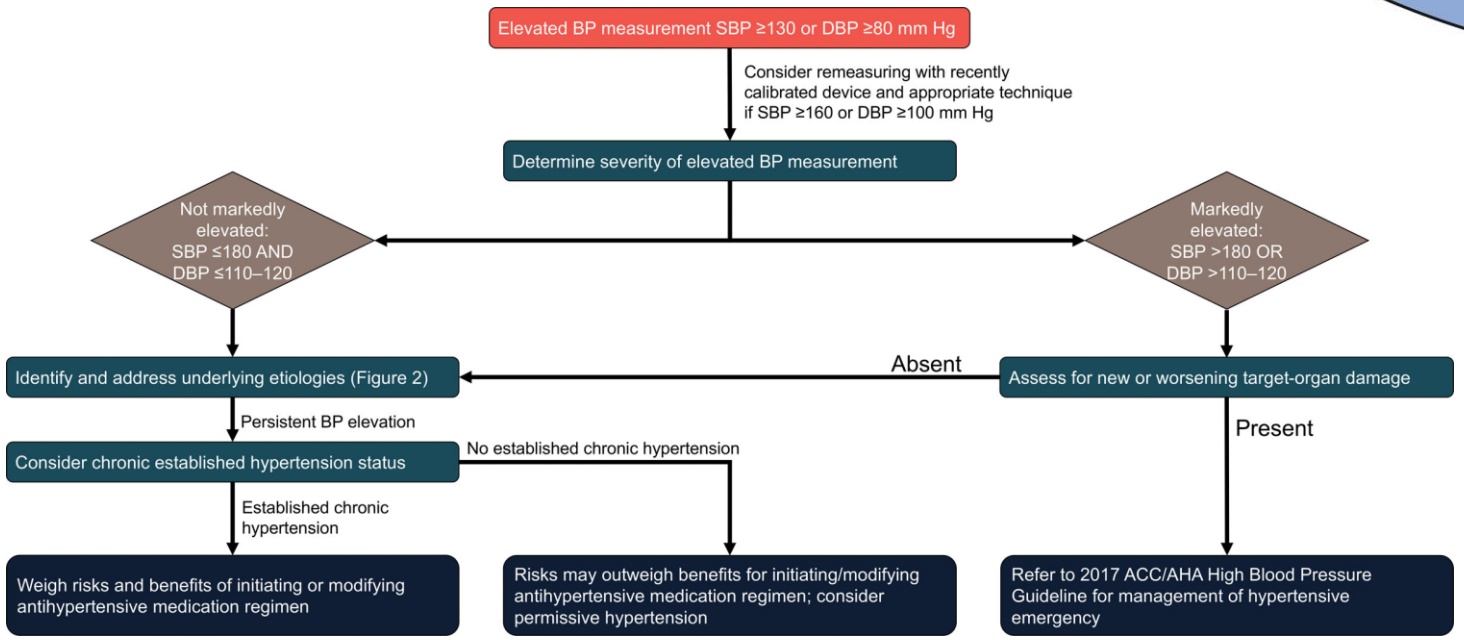


Whelton, P. K., et al. (2018). "2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines." Hypertension **71**(6): e13-e115.

Inpatient Hypertension

To Treat or Not to Treat?





Bress AP, Anderson TS, Flack JM, Ghazi L, Hall ME, Laffer CL, Still CH, Taler SJ, Zachrison KS, Chang TI; American Heart Association Council on Hypertension; Council on Cardiovascular and Stroke Nursing; and Council on Clinical Cardiology. The Management of Elevated Blood Pressure in the Acute Care Setting: A Scientific Statement From the American Heart Association. Hypertension. 2024 Aug;81(8):e94-e106.

What is the optimal BP goal in most patients with diabetes and hypertension?

A: <140/90 mmHg

B: <135/85 mmHg

C: <130/80 mmHg

D: <140/90, <150/90 age over 60

What is the optimal BP goal in most patients with diabetes and hypertension?

A: <140/90 mmHg

B: <135/85 mmHg

C: <130/80 mmHg

D: <140/90, <150/90 age over 60

Differences between Guidelines

2003 JNC7 <130/80 mmHg

2013 ADA <140/90 mmHg

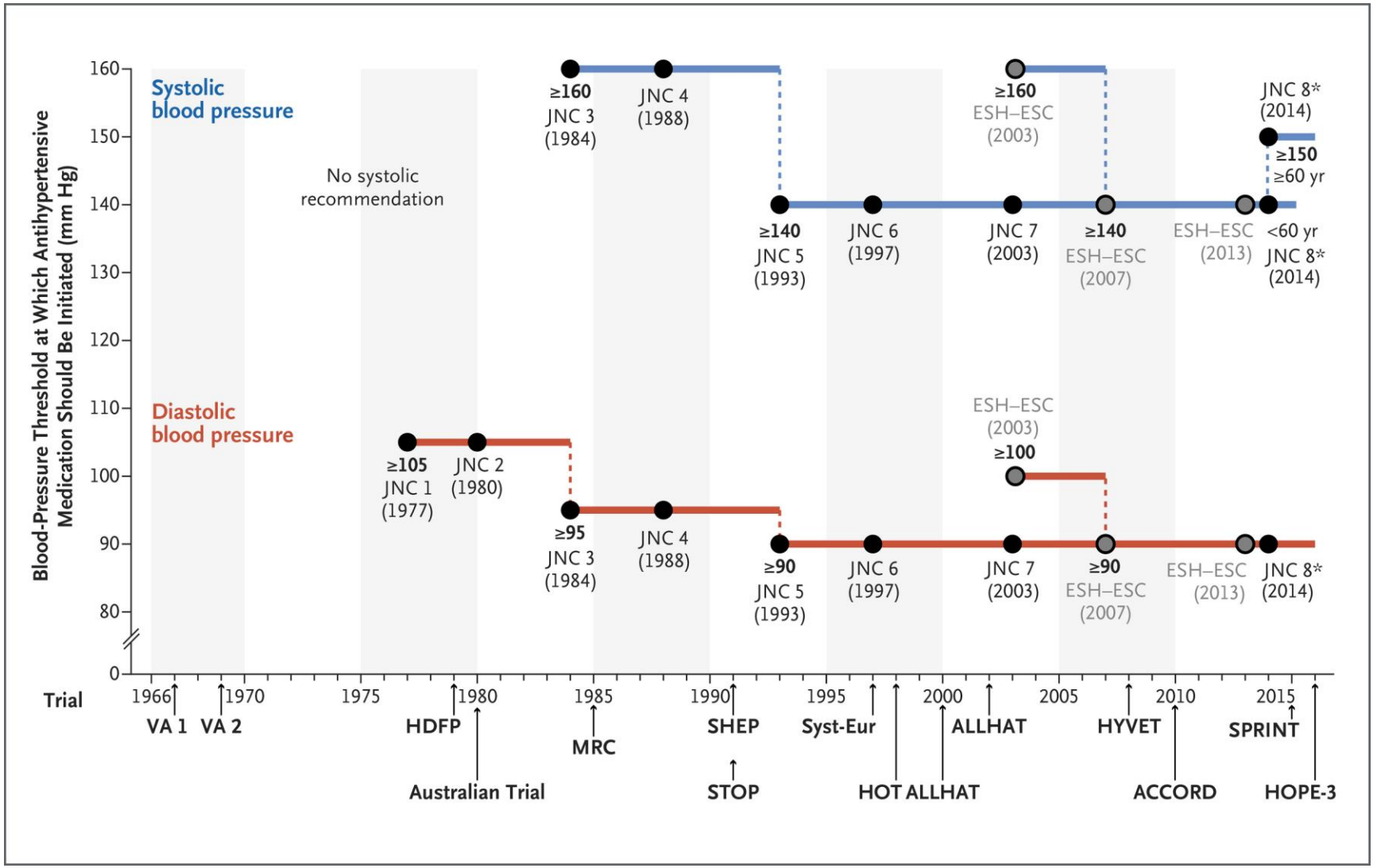
2017 AHA/ACC <130/80 mmHg

2017 ADA <140/90 mmHg

2023 ADA <130/80 mmHg

2023 ESH <140/80 mmHg

Moving Targets



Pfeffer MA, McMurray JJ. Lessons in Uncertainty and Humility - Clinical Trials Involving Hypertension. N Engl J Med. 2016 Nov 3;375(18):1756-1766.

UKPDS (Lancet 1998)

1,148 hypertensive patients (age 56, mean BP 160/94)

Primary Outcome: Intensive glucose control improved microvascular morbidity but not mortality

BP control tested also:
"Tight control" <150/85 mmHg

Less tight control <180/105 mmHg

Intensive **BP control** improved morbidity (micro- and macro-vascular) and mortality

Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). UK Prospective Diabetes Study (UKPDS) Group. Lancet. 1998 Sep 12;352(9131):837-53.

ADVANCE (Lancet 2007)

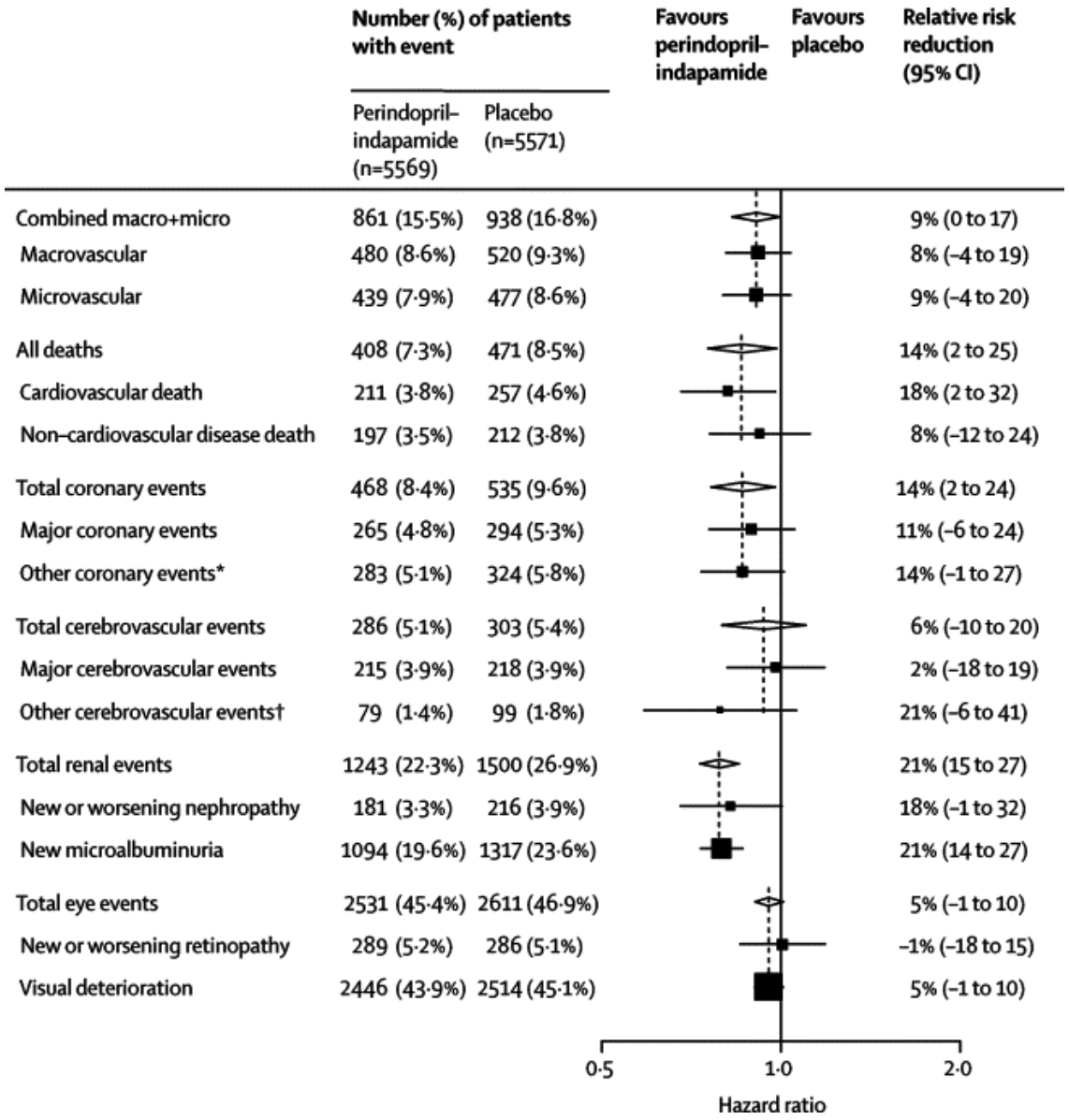
11,140 patients: [Perindopril + Indapamide] vs Placebo

SBP fell 6/2 mm Hg with active therapy: 135/75 vs 140/77

BP lowering led to 9% lower rate of macro- and micro-vascular events

Lower rate of CV and all cause mortality not seen with intensive glucose control

Patients with T2DM benefit from BP< 130/80mm Hg
* regardless of baseline BP or 10-year ASCVD risk
* down to <120/70 mm Hg, benefit persisted

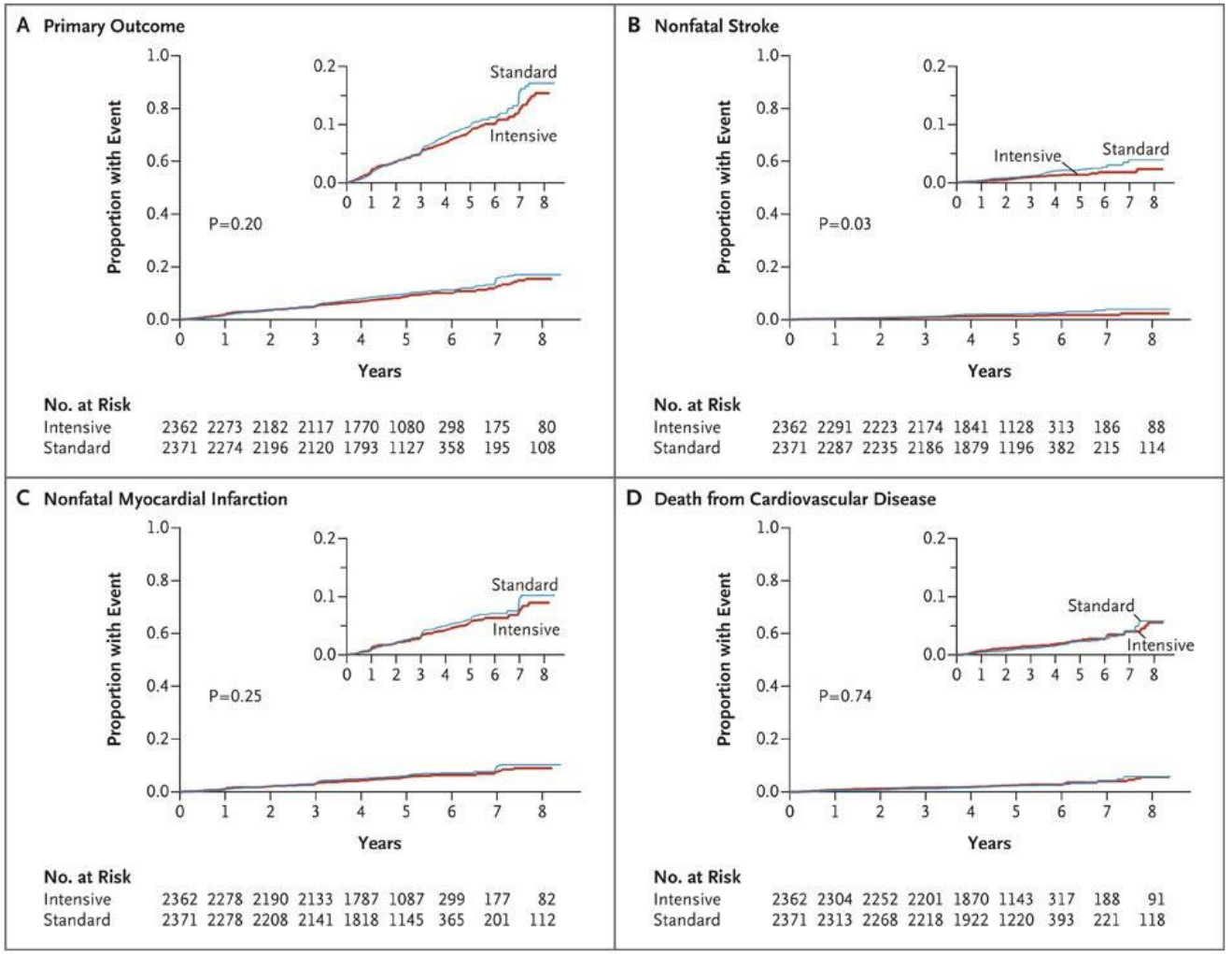


Patel A; ADVANCE Collaborative Group; MacMahon S, Chalmers J, Neal B, Woodward M, Billot L, Harrap S, Poulter N, Marre M, Cooper M, Glasziou P, Grobbee DE, Hamet P, Heller S, Liu LS, Mancia G, Mogensen CE, Pan CY, Rodgers A, Williams B. Effects of a fixed combination of perindopril and indapamide on macrovascular and microvascular outcomes in patients with type 2 diabetes mellitus (the ADVANCE trial): a randomised controlled trial. Lancet. 2007 Sep 8;370(9590):829-40.

ACCORD (NEJM 2010)

Standard < 140mmHg vs
Intensive <120mmHg

Intensive BP control in DM does not reduce a composite of adverse CV events, but does reduce the rate of stroke



ACCORD Study Group; Cushman WC, Evans GW, Byington RP, Goff DC Jr, Grimm RH Jr, Cutler JA, Simons-Morton DG, Basile JN, Corson MA, Probstfield JL, Katz L, Peterson KA, Friedewald WT, Buse JB, Bigger JT, Gerstein HC, Ismail-Beigi F. Effects of intensive blood-pressure control in type 2 diabetes mellitus. N Engl J Med. 2010 Apr 29;362(17):1575-85.

SPRINT (NEJM 2015)

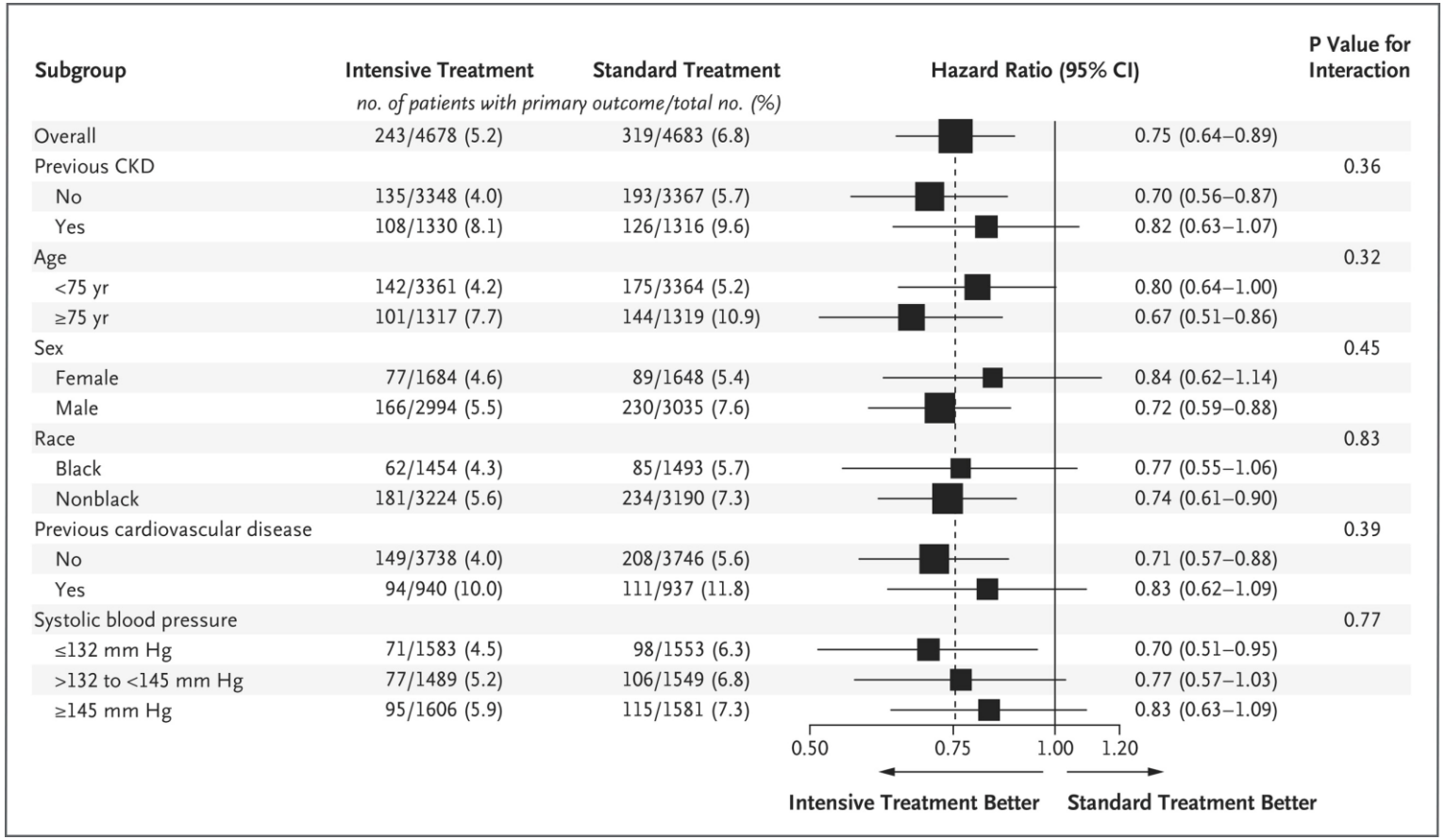
102 clinical sites, 6 year follow up
9,361 patients, >50 years old

- Baseline SBP 130 – 180 mmHg
- Increased risk of CV events
- Excluded DM and prior stroke

Lower target (<120mmHg) translated to fewer events: fatal and nonfatal CV events and all cause mortality

Intense treatment group

- **25% lower relative risk of primary outcome**
- **27% lower relative risk of death from any cause**



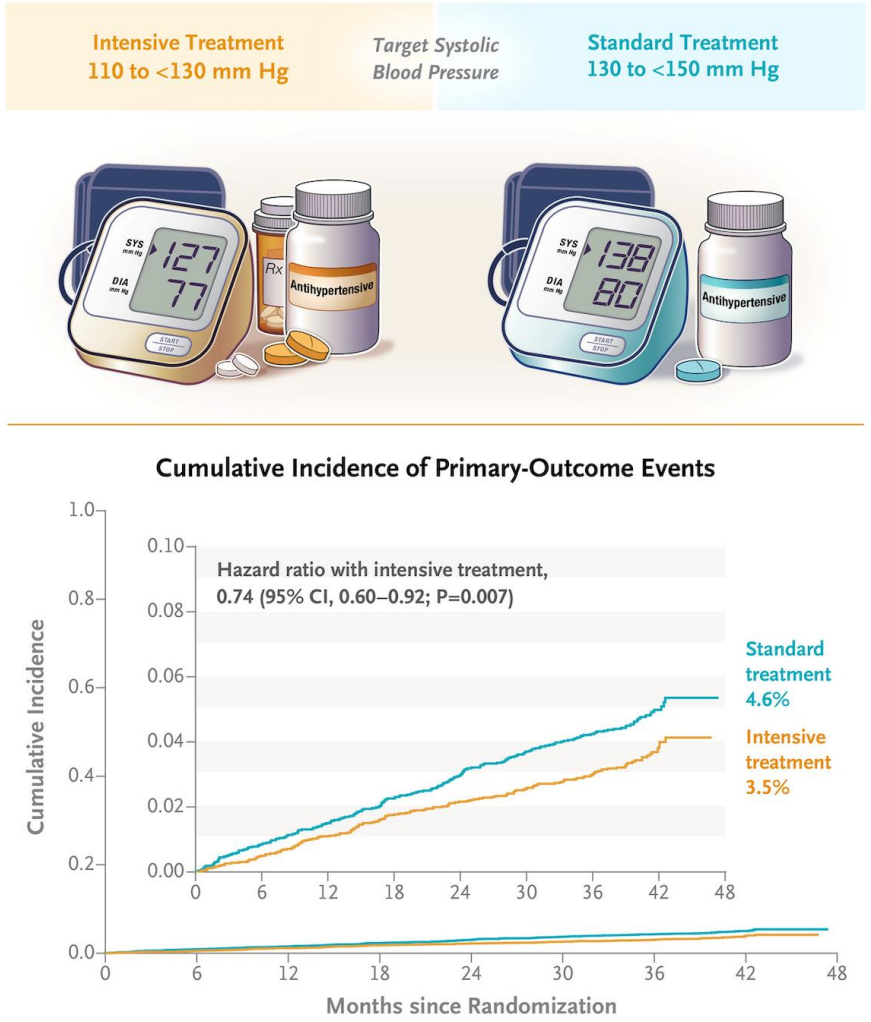
Subgroup	Intensive Treatment	Standard Treatment	Hazard Ratio (95% CI)	P Value for Interaction
	no. of patients with primary outcome/total no. (%)			
Overall	243/4678 (5.2)	319/4683 (6.8)	0.75 (0.64–0.89)	
Previous CKD				0.36
No	135/3348 (4.0)	193/3367 (5.7)	0.70 (0.56–0.87)	
Yes	108/1330 (8.1)	126/1316 (9.6)	0.82 (0.63–1.07)	
Age				0.32
<75 yr	142/3361 (4.2)	175/3364 (5.2)	0.80 (0.64–1.00)	
≥75 yr	101/1317 (7.7)	144/1319 (10.9)	0.67 (0.51–0.86)	
Sex				0.45
Female	77/1684 (4.6)	89/1648 (5.4)	0.84 (0.62–1.14)	
Male	166/2994 (5.5)	230/3035 (7.6)	0.72 (0.59–0.88)	
Race				0.83
Black	62/1454 (4.3)	85/1493 (5.7)	0.77 (0.55–1.06)	
Nonblack	181/3224 (5.6)	234/3190 (7.3)	0.74 (0.61–0.90)	
Previous cardiovascular disease				0.39
No	149/3738 (4.0)	208/3746 (5.6)	0.71 (0.57–0.88)	
Yes	94/940 (10.0)	111/937 (11.8)	0.83 (0.62–1.09)	
Systolic blood pressure				0.77
≤132 mm Hg	71/1583 (4.5)	98/1553 (6.3)	0.70 (0.51–0.95)	
>132 to <145 mm Hg	77/1489 (5.2)	106/1549 (6.8)	0.77 (0.57–1.03)	
≥145 mm Hg	95/1606 (5.9)	115/1581 (7.3)	0.83 (0.63–1.09)	

SPRINT Research Group; Wright JT Jr, Williamson JD, Whelton PK, Snyder JK, Sink KM, Rocco MV, Reboussin DM, Rahman M, Oparil S, Lewis CE, Kimmel PL, Johnson KC, Goff DC Jr, Fine LJ, Cutler JA, Cushman WC, Cheung AK, Ambrosius WT. A Randomized Trial of Intensive versus Standard Blood-Pressure Control. N Engl J Med. 2015 Nov 26;373(22):2103-16.

STEP Study (NEJM 2021)

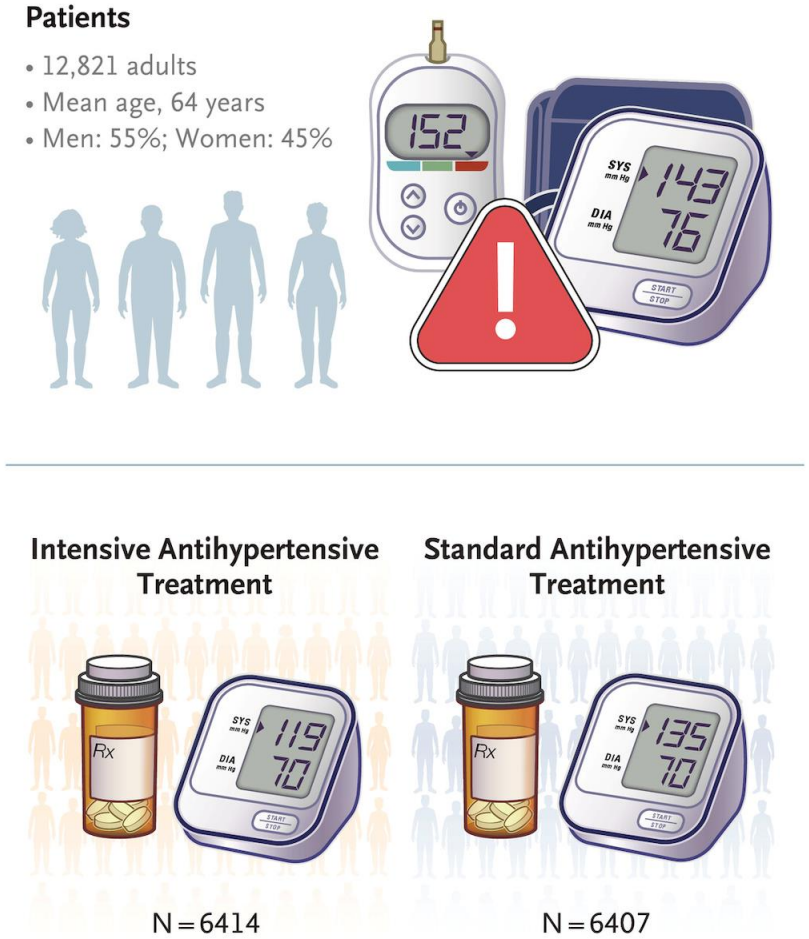
Intensive BP control in older patients (60-80 years of age) with hypertension reduced CV outcomes

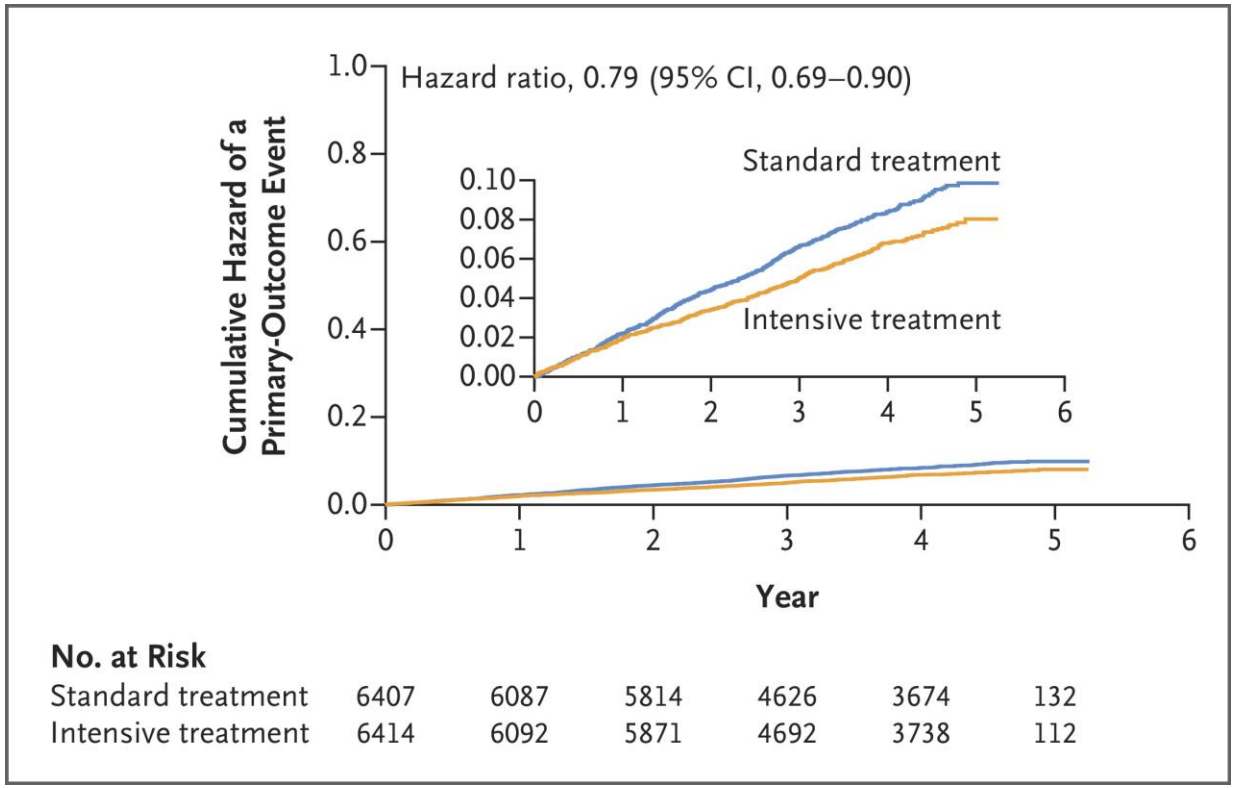
N=8,511
20% had diabetes
3.34 year follow up



Zhang W, Zhang S, Deng Y, Wu S, Ren J, Sun G, Yang J, Jiang Y, Xu X, Wang TD, Chen Y, Li Y, Yao L, Li D, Wang L, Shen X, Yin X, Liu W, Zhou X, Zhu B, Guo Z, Liu H, Chen X, Feng Y, Tian G, Gao X, Kario K, Cai J; STEP Study Group. Trial of Intensive Blood-Pressure Control in Older Patients with Hypertension. N Engl J Med. 2021 Sep 30;385(14):1268-1279.

Intensive Blood-Pressure Control in Patients with Type 2 Diabetes (NEJM 2024)





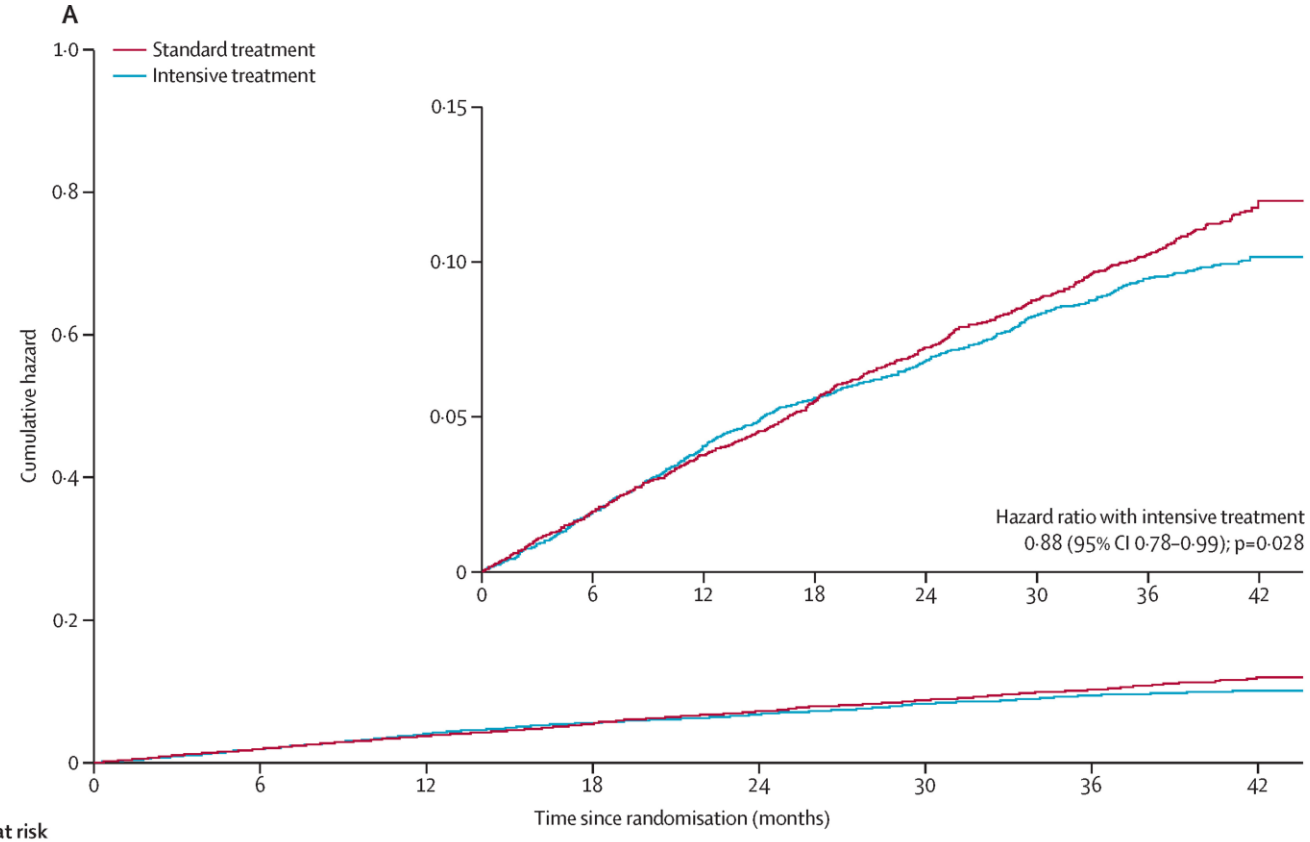
Intensive-treatment group: mean SBP 121.6 mm Hg (median, 118.3 mm Hg)

Standard-treatment group: mean SBP 133.2 mm Hg (median, 135.0 mm Hg)

Bi Y, Li M, Liu Y, Li T, Lu J, Duan P, Xu F, Dong Q, Wang A, Wang T, Zheng R, Chen Y, Xu M, Wang X, Zhang X, Niu Y, Kang Z, Lu C, Wang J, Qiu X, Wang A, Wu S, Niu J, Wang J, Zhao Z, Pan H, Yang X, Niu X, Pang S, Zhang X, Dai Y, Wan Q, Chen S, Zheng Q, Dai S, Deng J, Liu L, Wang G, Zhu H, Tang W, Liu H, Guo Z, Ning G, He J, Xu Y, Wang W; BPROAD Research Group. Intensive Blood-Pressure Control in Patients with Type 2 Diabetes. N Engl J Med. 2025 Mar 27;392(12):1155-1167.

Lowering SBP to <120 mm Hg vs <140 mm Hg in patients with **high cardiovascular risk** with and without diabetes or previous stroke (Lancet 2024)

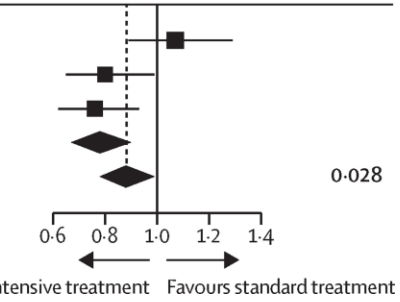
Death from cardiovascular causes occurred in 59 (1.1%) from the intensive treatment group and in 97 (1.7%) from the standard treatment group (HR 0.61; 95% CI 0.44–0.84).



Number at risk (number censored)								
Standard treatment	5631	5519 (4)	5410 (10)	5299 (24)	5183 (42)	5081 (57)	3955 (1106)	389 (4619)
Intensive treatment	5624	5510 (6)	5380 (18)	5279 (31)	5197 (45)	5097 (64)	3967 (1132)	400 (4677)

B

First event	(n participants with event [% per year])		Hazard ratio (95% CI)	p value
	Intensive treatment	Standard treatment		
≤1 year	226 (4·1%)	211 (3·8%)	1·07 (0·89–1·29)	
>1 year to ≤2 years	156 (3·0%)	195 (3·7%)	0·80 (0·65–0·99)	
>2 years	165 (2·6%)	217 (3·4%)	0·76 (0·62–0·93)	
>1 year	321 (2·7%)	412 (3·5%)	0·78 (0·67–0·90)	
Overall	**547 (3·2%)**	**623 (3·6%)**	**0·88 (0·78–0·99)**	**0·028**



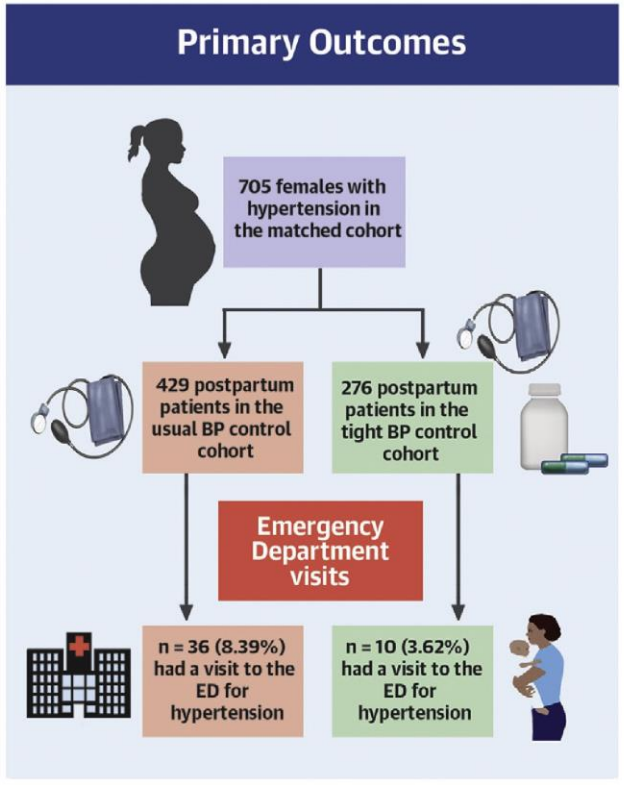
Liu J, Li Y, Ge J, Yan X, Zhang H, Zheng X, Lu J, Li X, Gao Y, Lei L, Liu J, Li J; ESPRIT Collaborative Group. Lowering systolic blood pressure to less than 120 mm Hg versus less than 140 mm Hg in patients with high cardiovascular risk with and without diabetes or previous stroke: an open-label, blinded-outcome, randomised trial. Lancet. 2024 Jul 20;404(10449):245-255.

Post-Partum?

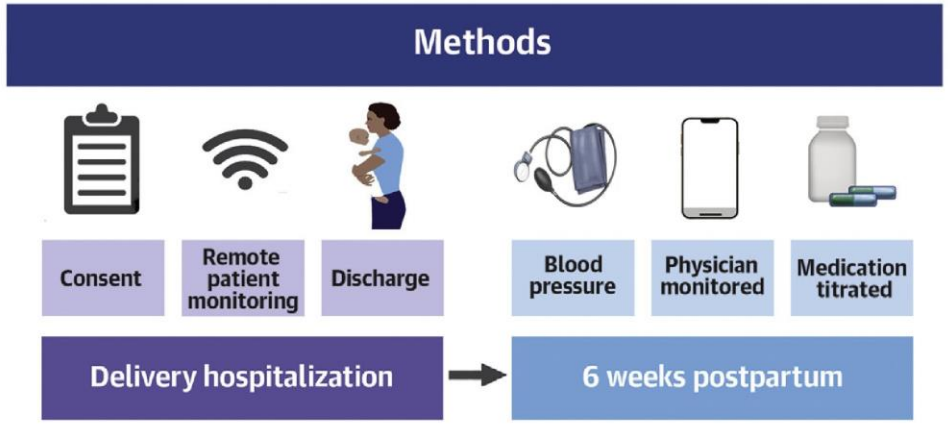
ED visits for hypertension:

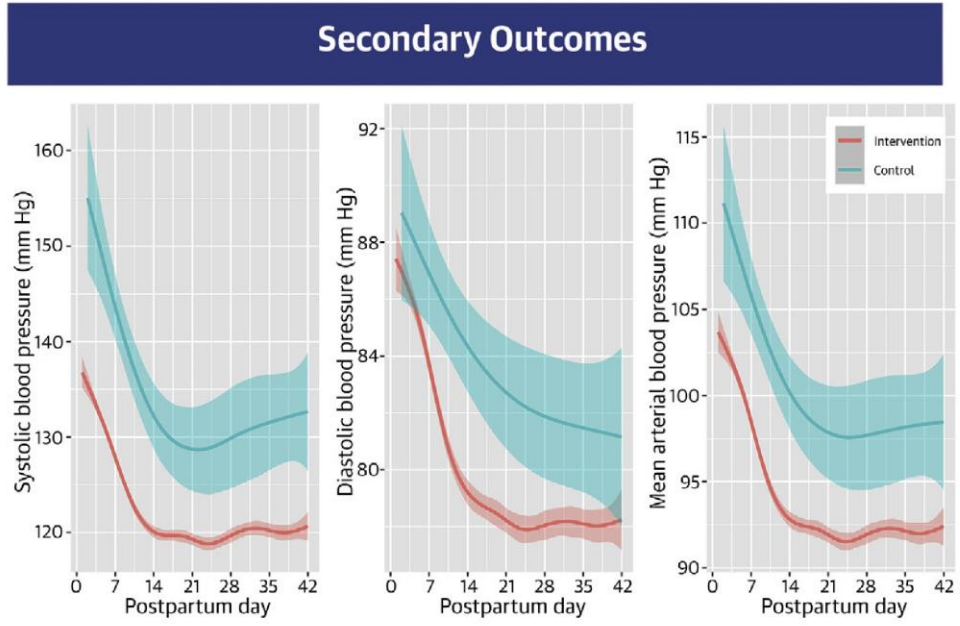
- 3.6% of the intervention group (<130/80)
- 8.4% of the control group (<150/100)

CENTRAL ILLUSTRATION: Management of Postpartum Preeclampsia and Hypertensive Disorders (MOPP): Postpartum Tight vs Standard Blood Pressure Control



Tight blood pressure (BP) control reduces Emergency Department visits by 68% (aOR: 0.32, 95% CI: 01.10-1.01) in the postpartum period





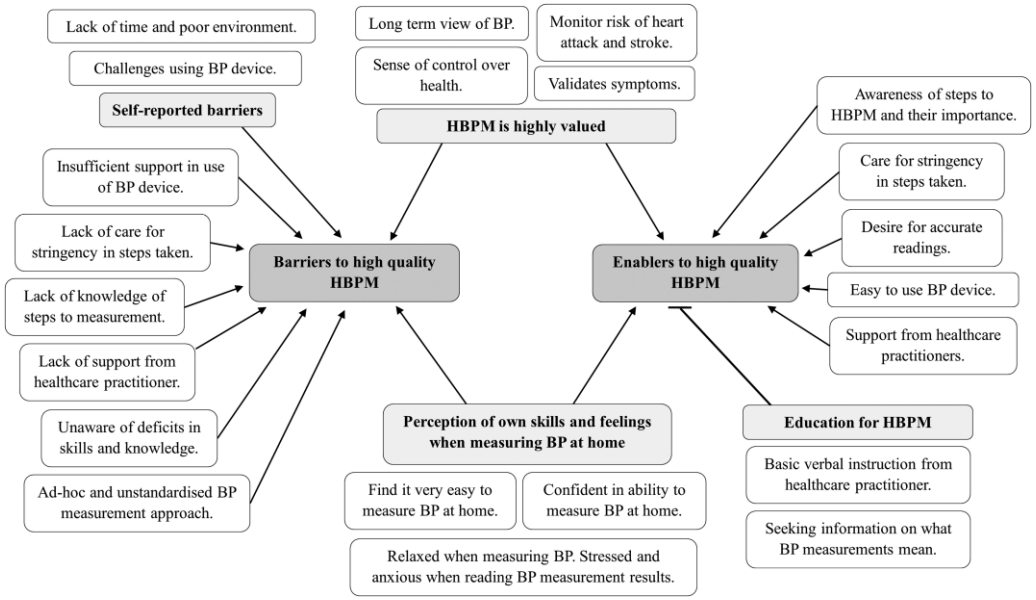
Rosenfeld EB, et al. JACC Adv. 2025;4(3):101617.

Out-of-Office and Self-Monitored BPs are Recommended

COR	LOE	ACC/AHA 2017
I	A	Out-of-office BP measurements recommended to confirm diagnosis of hypertension and for titration of BP-lowering medication, in conjunction with telehealth counseling or clinical interventions.

validatebp.org
medaval.ie
STRIDE BP.org

We Need Standardized Education



Home blood pressure measurements (HBPM) are not performed according to guidelines and standardized education is urgently needed

n=350
Aged 58±16 years, 54% women

+

n=34

HBPM practice

"I measure blood pressure at different times of the day after doing different things".

Recommendations performed by adults:

- 90% measured BP seated
- 77% with cuff fitted to a bare arm
- 78% reported BP to doctor
- 26% averaged BP readings taken over 7 days
- 15% measured BP in the morning and evening

HBPM education & training

Education was ***"ad-hoc"***

37% received education for HBPM

93% sought information online or from health providers

"I'm pretty confident on how to use a machine, the information was more understanding what it [BP] meant"

Participants that received education **did not perform higher quality HBPM** than those that did not receive education.

Adults should be supported for HBPM by delivering patient education that provides accurate, appropriate and actionable information.

Clapham E, Picone DS, Carmichael S, Stergiou GS, Campbell NRC, Stevens J, Batt C, Schutte AE, Chapman N. Home Blood Pressure Measurements Are Not Performed According to Guidelines and Standardized Education Is Urgently Needed. Hypertension. 2025 Jan;82(1):149-159.

Wally Monster

Name:
Tel Numb
BWH ID#:
Medications: labetold 300 bid

	AM before pills	Repeat AM	Eve before pills	Repeat
Day 1	123/79	123/82	111/72	126/75
Day 2	126/78	123/86	128/84	134/84
Day 3	138/84	138/84	154/99	157/101 Soar throat run down
Day 4	134/87	133/84	125/82	129/78
Day 5	134/88	126/86	117/76	115/69
Day 6	127/82	126/81	132/89	133/87
Day 7	135/77	122/75	120/72	109/70

Average BP from days 2-7:

First Morning	131/82.7	**First Night**	129.3/83.7
Second Morning	128/82.7	**Second Night**	129.5/81.5

Do not smoke, drink caffeinated beverages or exercise 30 minutes before measuring your pressure.

Remote Hypertension Management is Effective

Long-Term Blood Pressure Trends Following A Remote Hypertension Intervention

Secondary Analysis of a Remote Hypertension Management Program

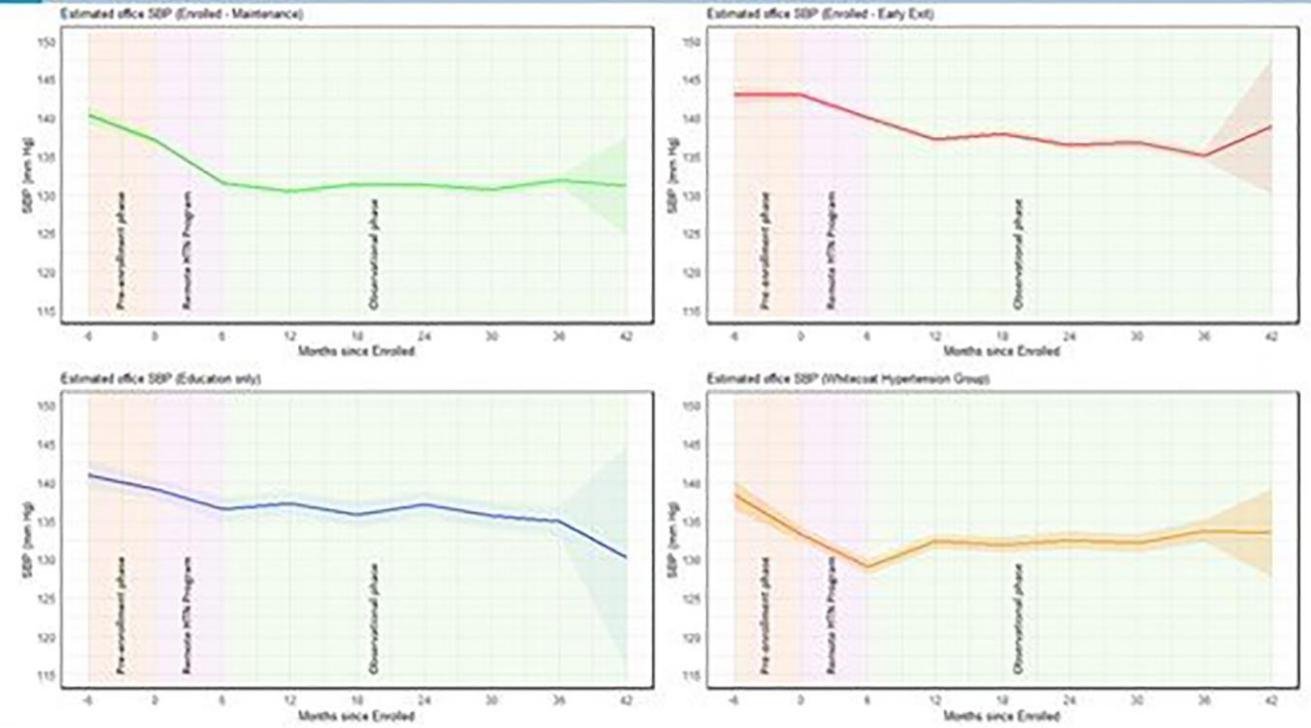
A navigator-driven, pharmacist-led, algorithm-based remote program that managed the blood pressure of 3,658 participants within the Mass General Brigham healthcare system.

Design

Retrospective Cohort	Data from 3,601 participants	57,475 office BP readings from EHR	From enrollment to 42-months post-enrollment

Results

All groups sustained mean office SBP reductions below qualifying values up to 42-months post-enrollment. In the maintenance group, 90% participants maintained their mean office SBP ≤140 mm Hg, up to 42-months. Age ≥50 y was significantly associated with higher likelihood of above-goal SBP in the maintenance group.



Conclusion

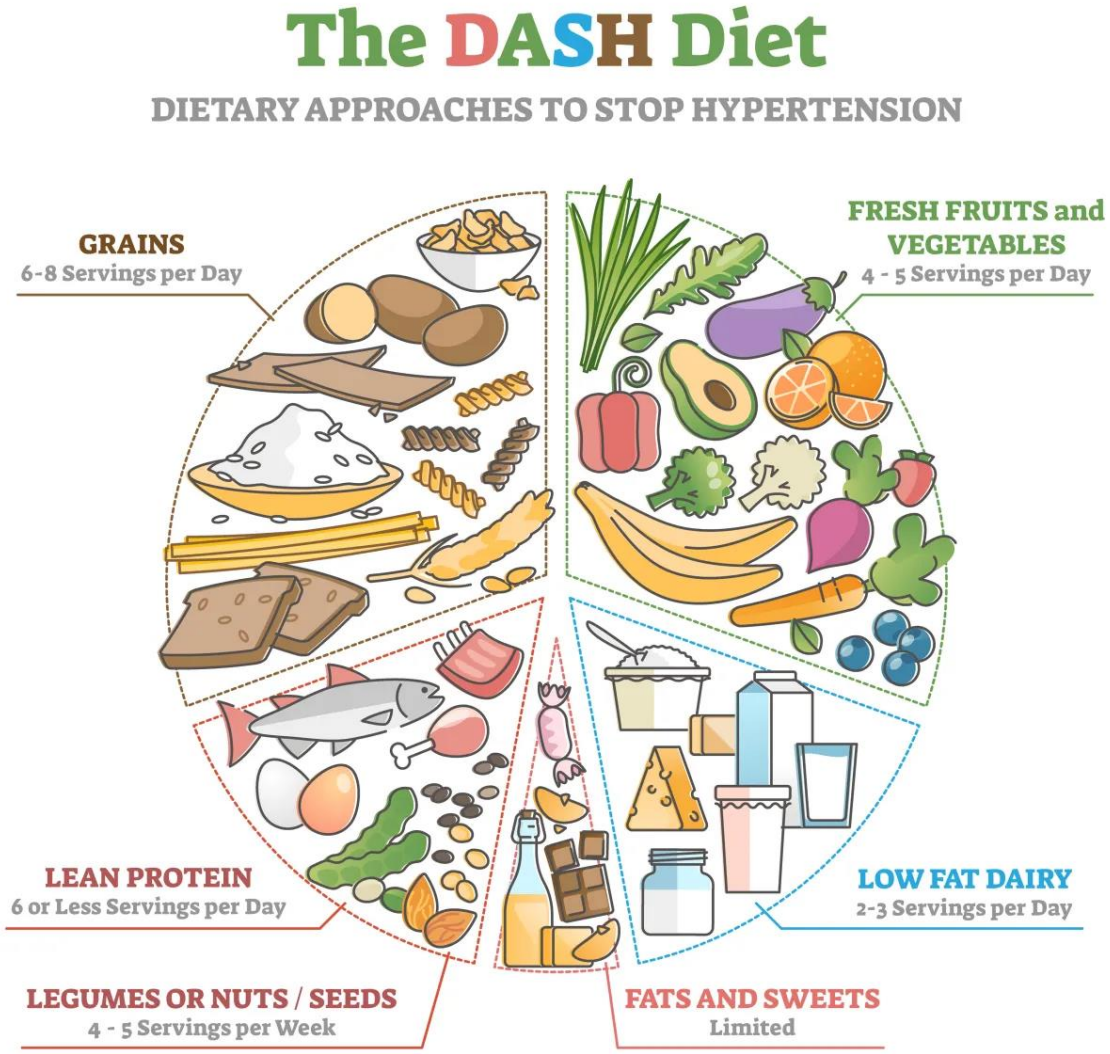
A time limited remote hypertension management program effectively achieved and sustained BP control at the population level, demonstrating its scalability for broader implementation.Tailored approaches are needed to ensure equitable access and engagement, especially in older and underserved populations.

Hassan S, Blood AJ, Zelle D, Kumar S, Wagholikar K, Gabovitch D, Cannon CP, Fisher N, Scirica BM. The Long-Term Blood Pressure Trends Following a Remote Hypertension Intervention: A Secondary Analysis of the Digital Care Transformation - Remotely Delivered Hypertension Management Program. Hypertension. 2025 Apr;82(4):733-742.

Lifestyle Modifications Come First

For patients with BP>120/80 mmHg, lifestyle intervention is recommended:

- Weight loss if overweight or obese
- DASH-style diet
- Reduced sodium intake
  - AHA 1500mg
  - FDA 2300mg unless higher risk profile
  - Americans consume: 3,500-4,000mg/day
- Moderation of alcohol intake
- Increased physical activity



Lifestyle Modification: **Patient's Work**

Modification	~SBP Reduction
Weight reduction	10 mmHg/10kg
DASH diet	11 mmHg
Sodium reduction	5-6 mmHg
Potassium rich diet	4-5 mmHg
Physical activity	5-8 mmHg
Moderation of alcohol	4 mmHg

Which drug classes have been proven to reduce cardiovascular risk in patients with Type II DM?

A: ACE-I and ARBs

B: ACE-I, ARBs, Beta Blockers, calcium channel blockers, and diuretics

C: ACE-I, ARBs, CCB, and diuretics

D: ACE-I and CCB

Which drug classes have been proven to reduce cardiovascular risk in patients with Type II DM?

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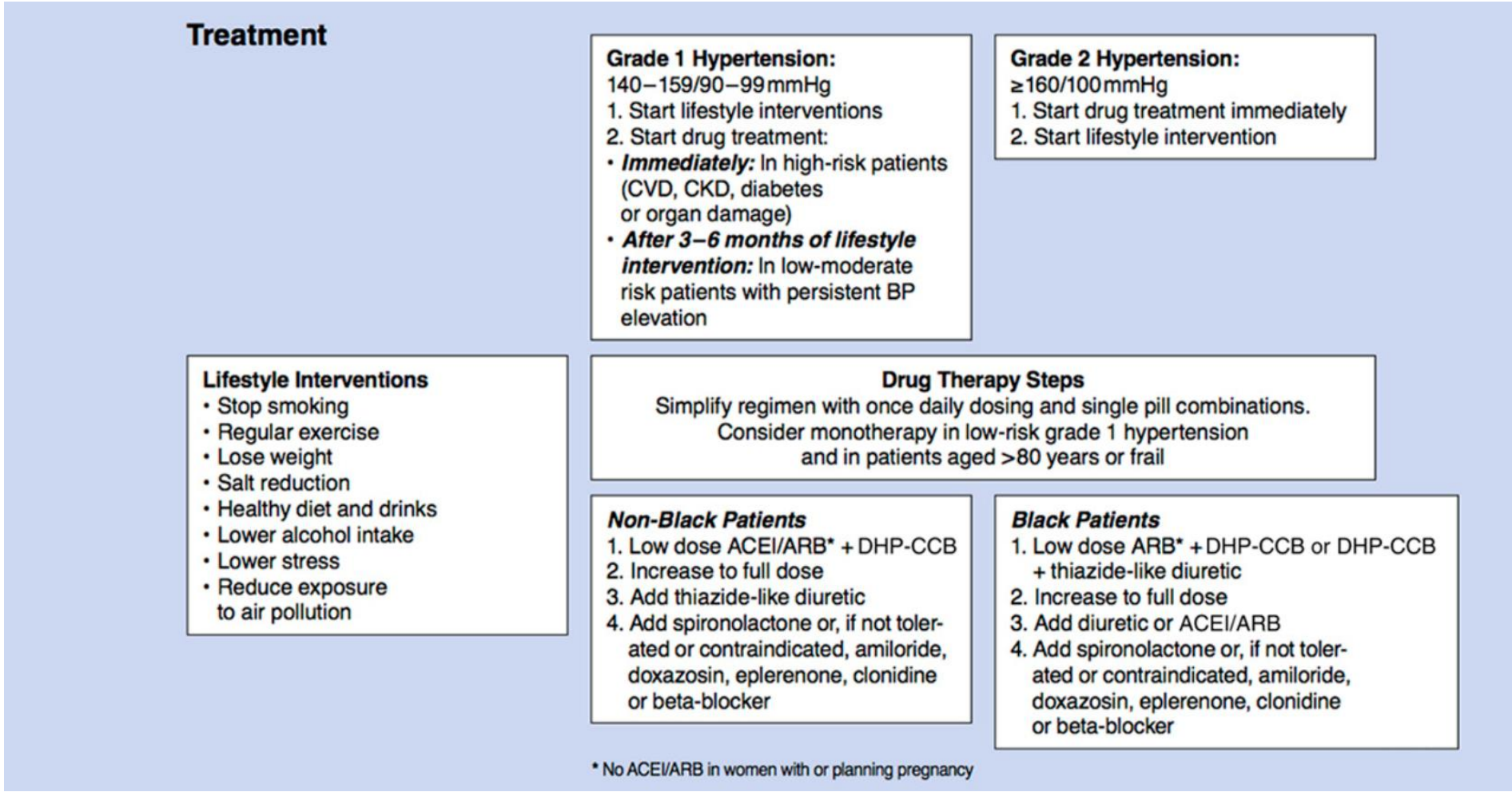
C: ACE-I, ARBs, CCB, and diuretics

D: ACE-I and CCB

A B C D of Hypertension Management

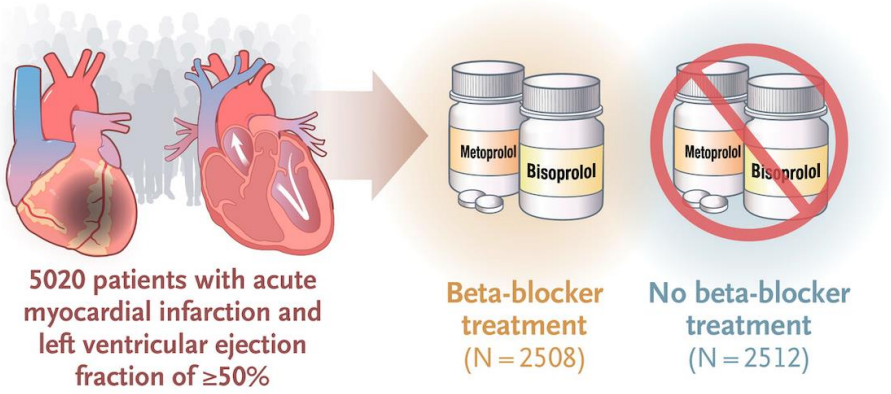
A	**ACE inhibitors** **ARB** **(do not combine)**	May improve glucose metabolism, lipid neutral Recommended 1st line treatment in patients with DM and UACR ≥ 300mg/g Use maximum tolerated dose
B	**Beta Blockers**	Worsen glucose control (not vasodilating BB: carvedilol, nebivolol, labetalol)
C	**Calcium Channel Blockers**	Lipid and glucose neutral No labs needed
D	**Thiazide-like Diuretics**	Reduces CHF Worsens glucose metabolism, lipids

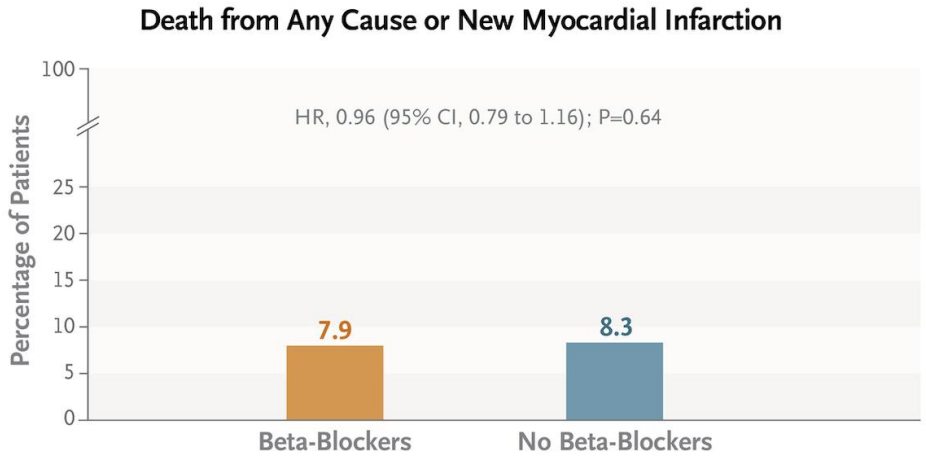
2020 International Society of Hypertension Global Practice Guidelines

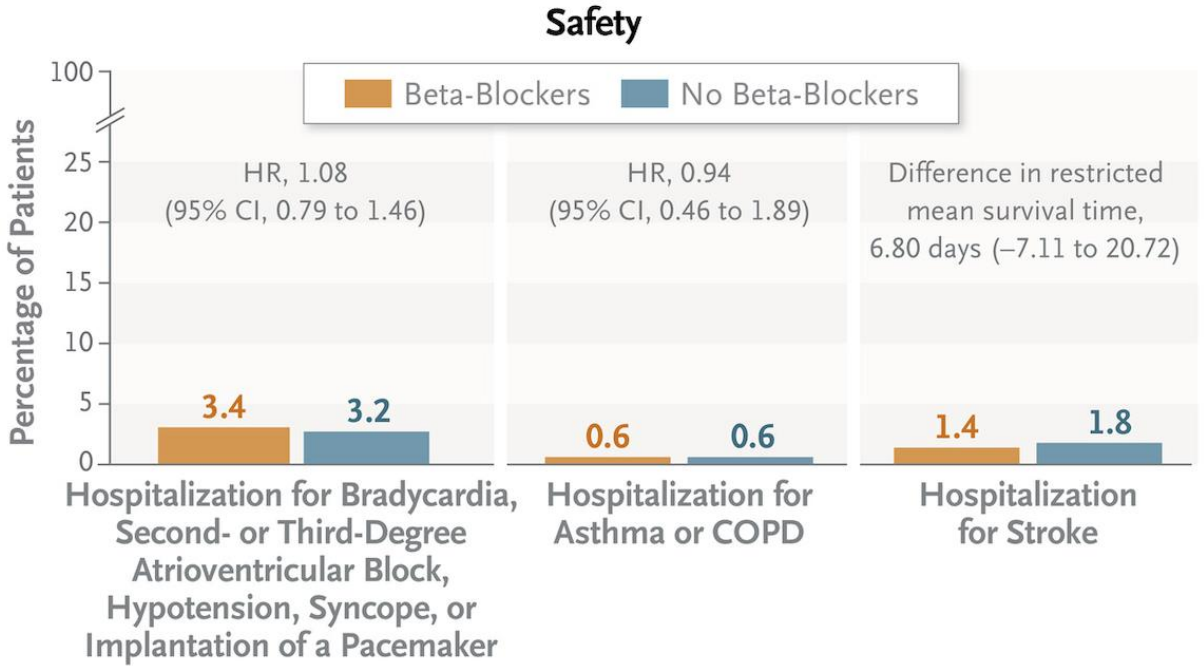


Unger T, Borghi C, Charchar F, Khan NA, Poulter NR, Prabhakaran D, Ramirez A, Schlaich M, Stergiou GS, Tomaszewski M, Wainford RD, Williams B, Schutte AE. 2020 International Society of Hypertension global hypertension practice guidelines. J Hypertens. 2020 Jun;38(6):982-1004.

Beta Blockers after acute MI?







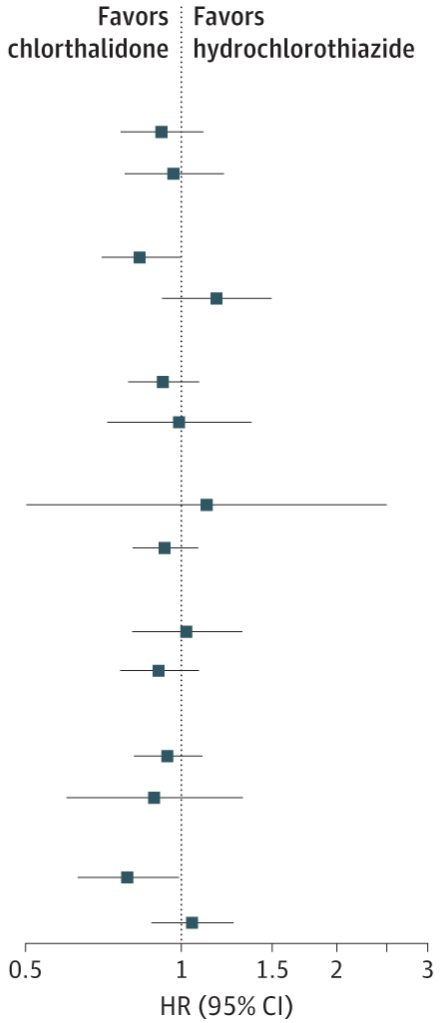
Following acute MI, patient who underwent early coronary angiography and had a preserved LVEF (≥50%), long-term beta-blocker treatment **did not** lead to a **lower risk of death from any cause or new myocardial infarction than no beta-blocker** use.

Yndigegn T, Lindahl B, Mars K, Alfredsson J, Benatar J, Brandin L, Erlinge D, Hallen O, Held C, Hjalmarsson P, Johansson P, Karlström P, Kellerth T, Marandi T, Ravn-Fischer A, Sundström J, Östlund O, Hofmann R, Jernberg T; REDUCE-AMI Investigators. Beta-Blockers after Myocardial Infarction and Preserved Ejection Fraction. N Engl J Med. 2024 Apr 18;390(15):1372-1381.

Which Thiazide? HCTZ versus Chlorthalidone

Chlorthalidone is **not superior** to hydrochlorothiazide in the incidence of the primary or secondary composite kidney outcome.

Subgroup	Total No. of patients	No. (%) of patients with outcome	HR (95% CI)	*P* for interaction
eGFR, mL/min/1.73 m^2				.71
≥60	9038	452 (5.0)	0.92 (0.76-1.11)	
<60	3227	313 (9.7)	0.97 (0.78-1.21)	
Age, y				.03
≤72	7320	508 (6.9)	0.84 (0.70-0.99)	
>72	4945	257 (5.2)	1.17 (0.92-1.50)	
Race				.70
Black	1837	148 (8.1)	0.99 (0.72-1.37)	
Other than Black	10428	617 (5.9)	0.93 (0.79-1.08)	
Sex				.65
Female	389	24 (6.2)	1.12 (0.50-2.51)	
Male	11876	741 (6.2)	0.93 (0.81-1.08)	
History of diabetes				.42
No	6640	253 (3.8)	1.03 (0.80-1.32)	
Yes	5625	512 (9.1)	0.91 (0.76-1.08)	
History of MI or stroke				.78
No	10936	665 (6.1)	0.94 (0.81-1.10)	
Yes	1329	100 (7.5)	0.89 (0.60-1.32)	
Baseline SBP, mm Hg				.05
≤136	5543	306 (5.5)	0.79 (0.63-0.99)	
>136	6722	459 (6.8)	1.05 (0.88-1.26)	



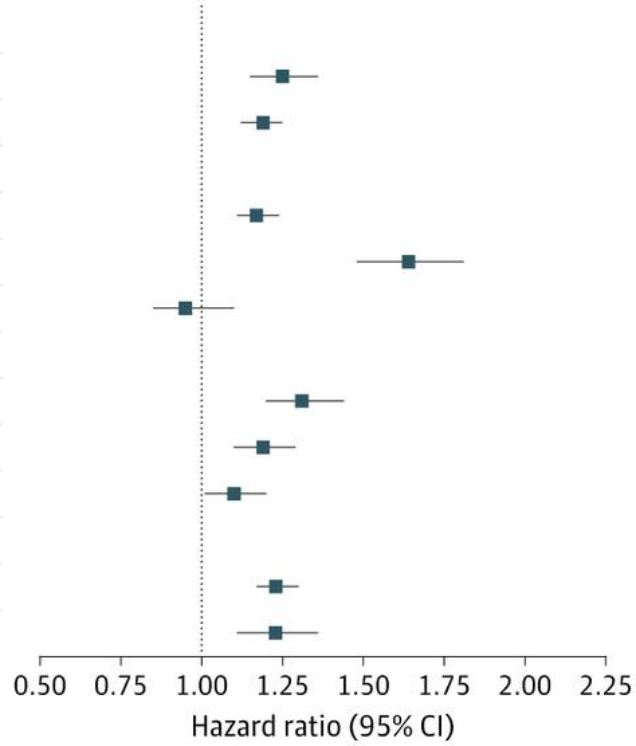
Ishani A, Hau C, Raju S, Wise JK, Glassman PA, Taylor AA, Ferguson RE, Cushman WC, Leatherman SM. Chlorthalidone vs Hydrochlorothiazide and Kidney Outcomes in Patients With Hypertension: A Secondary Analysis of a Randomized Clinical Trial. JAMA Netw Open. 2024 Dec 2;7(12):e2449576.

PRN?

133,760 patients hospitalized in Veterans Affairs hospitals

Use of PRN BP medication use associated with **greater risk** of AKI, rapid drop in blood pressure, and the composite outcome of stroke, myocardial infarction, or death.

	Total, No.	Hazard ratio (95% CI)
Type of as-needed BP medication given		
β-Blocker	15 234	1.25 (1.15-1.36)
Non-β-blocker	18 277	1.19 (1.12-1.25)
Route of as-needed BP medication administration		
Orally only	34 680	1.17 (1.11-1.24)
IV only	9482	1.64 (1.48-1.81)
Orally and IV	7896	0.95 (0.85-1.10)
Maximum systolic BP before as-needed BP medication administration, mm Hg		
140-159	11 870	1.31 (1.20-1.44)
160-179	17 894	1.19 (1.10-1.29)
≥180	12 602	1.10 (1.01-1.20)
As-needed BP medication order type		
One-time	40 008	1.23 (1.17-1.30)
Recurring (pro re nata)	12 070	1.23 (1.11-1.36)



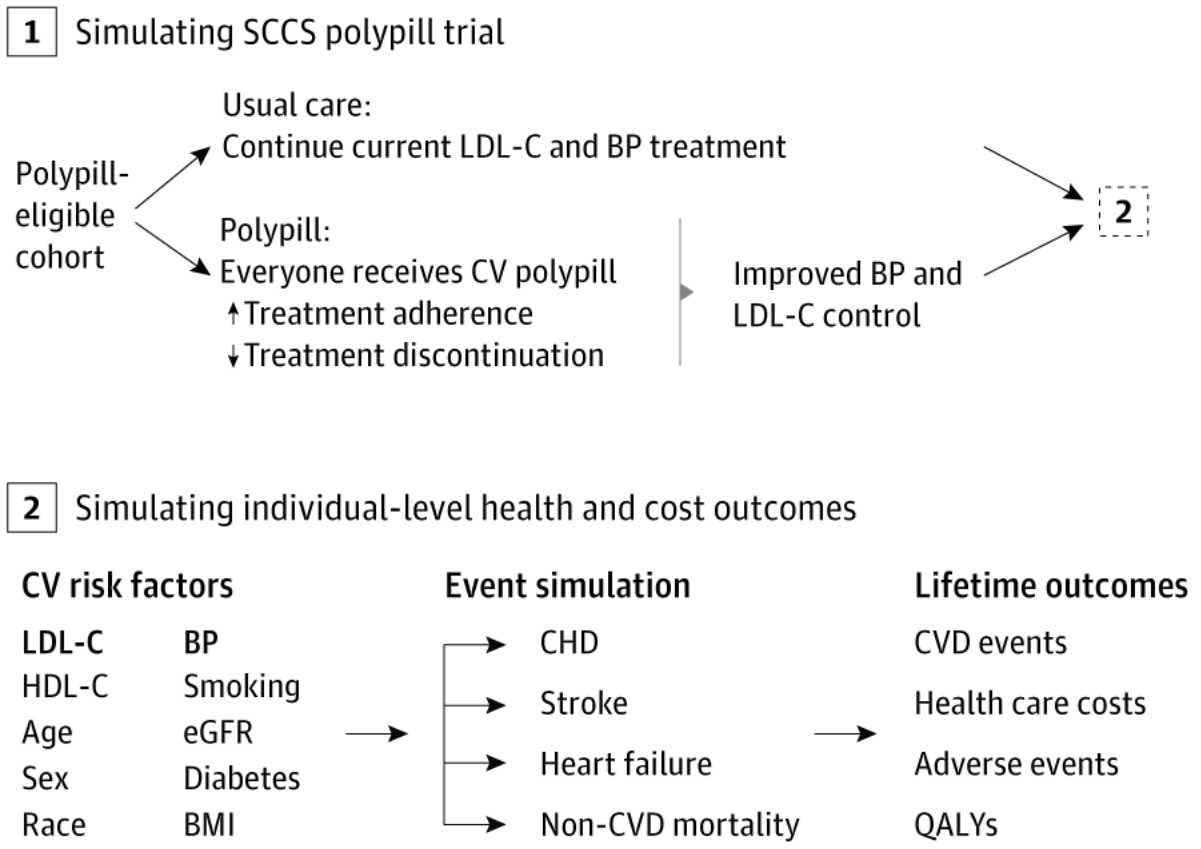
Canales MT, Yang S, Westanmo A, Wang X, Hadley D, Ishani A, Mohandas R, Shorr R, Lo-Ciganic W. As-Needed Blood Pressure Medication and Adverse Outcomes in VA Hospitals. JAMA Intern Med. 2025 Jan 1;185(1):52-60.

Polypill Simulation

Adherence and price: largest impact on cost-effectiveness of polypill treatment

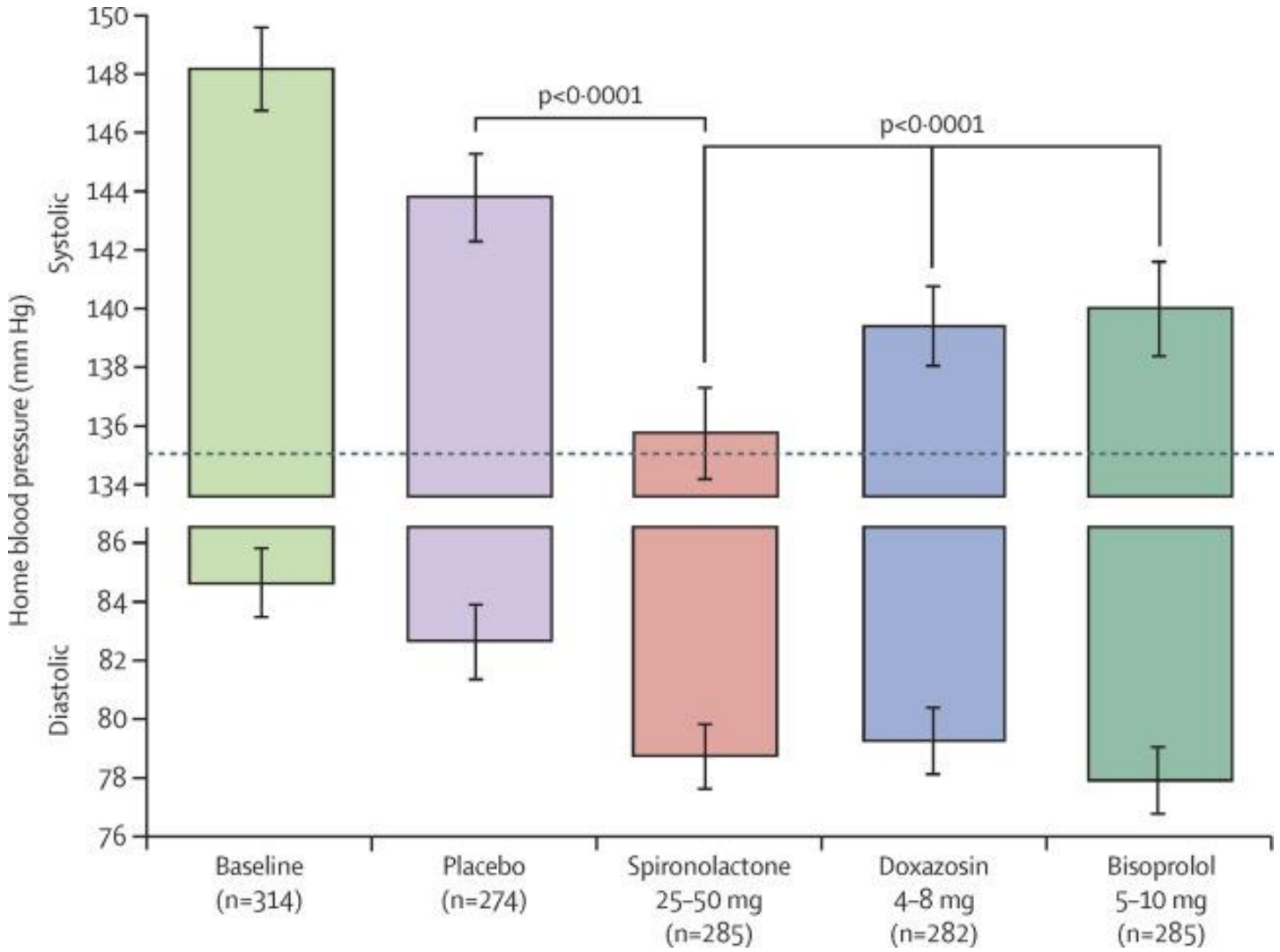
Polypill treatment would be
- cost saving at annual prices below $443
- high value at prices below $559

Over a lifetime, polypill treatment increased average life expectancy by over 3 months and remained highly cost-effective



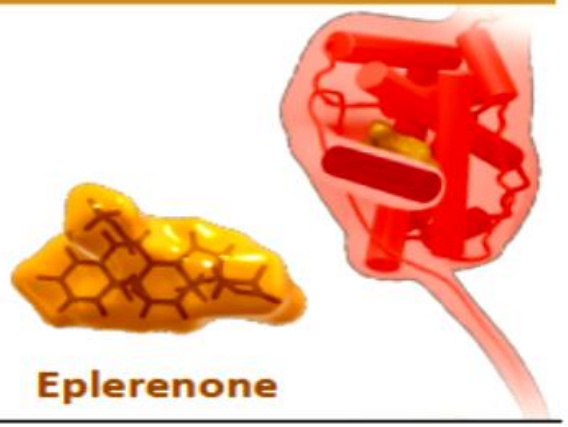
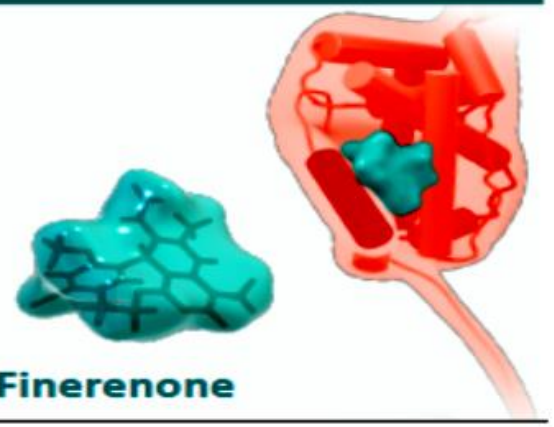
Kohli-Lynch CN, Moran AE, Kazi DS, Bibbins-Domingo K, Jordan N, French D, Zhang Y, Wang TJ, Bellows BK. Cost-Effectiveness of a Polypill for Cardiovascular Disease Prevention in an Underserved Population. JAMA Cardiol. 2025 Mar 1;10(3):224-233.

Spironolactone is the best 4th drug for Resistant Hypertension



Williams B, MacDonald TM, Morant S, Webb DJ, Sever P, McInnes G, Ford I, Cruickshank JK, Caulfield MJ, Salsbury J, Mackenzie I, Padmanabhan S, Brown MJ; British Hypertension Society's PATHWAY Studies Group. Spironolactone versus placebo, bisoprolol, and doxazosin to determine the optimal treatment for drug-resistant hypertension (PATHWAY-2): a randomised, double-blind, crossover trial. Lancet. 2015 Nov 21;386(10008):2059-2068.

Comparison of MRA inhibitors: Steroidal and Non-steriodal

	Steroidal MRAs		Finerenone
	 Spironolactone	 Eplerenone	 Finerenone
Structural properties	Flat (steroidal)	Flat (steroidal)	Bulky (nonsteroidal)
Potency to MR	+++	+	+++
Selectivity to MR	+	++	+++
CNS penetration	+	+	-
Sexual side effects	++	(+)	-
Half-life	> 20 hours	4-6 hours	2-3 hours
Active metabolites	++	-	-
Effect on BP	+++	++	+

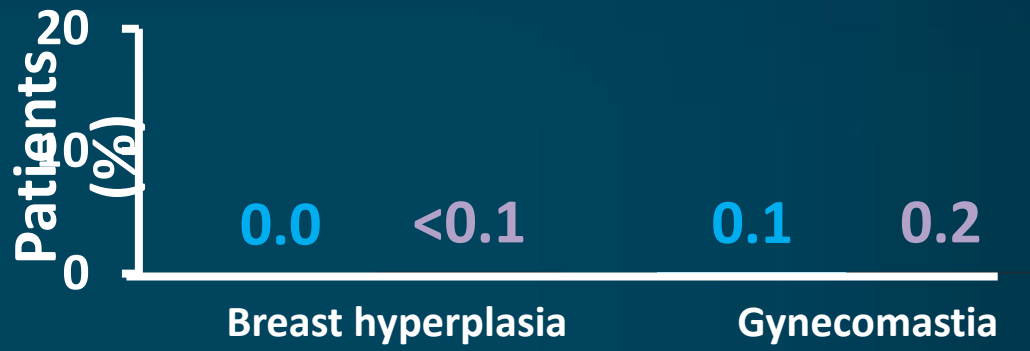
Kintscher U, Bakris GL, and Kolkhof P. *Br J Pharmacol 2021, in press*

Finerenone Showed Modest Effects on SBP and No Sexual Side Effects—Hyperkalemia Was Increased But Clinical Impact Was Low

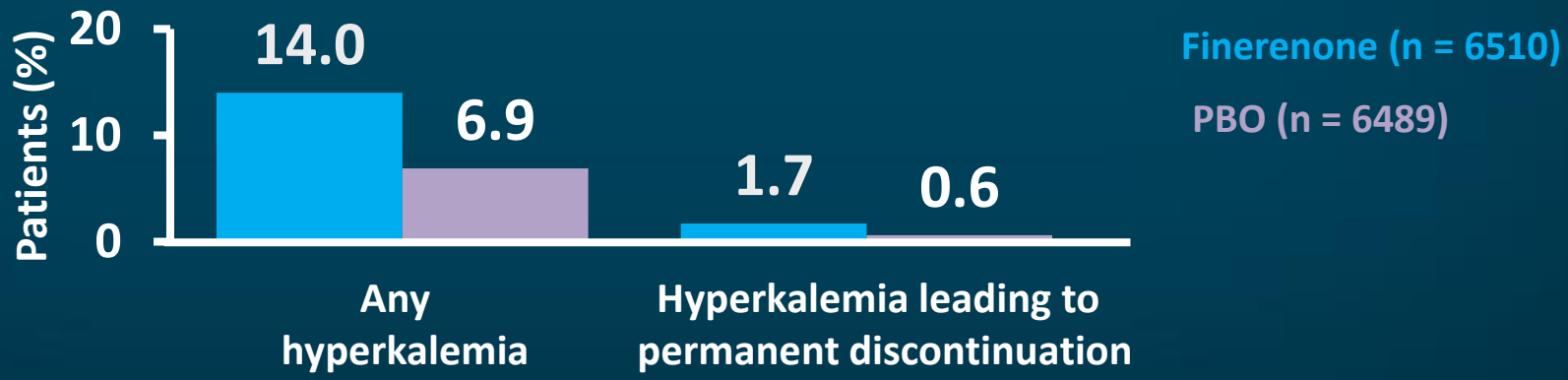
Modest effect on systolic blood pressure

Placebo-corrected change in mean SBP of –3.7 mmHg at 4 months

No sexual side-effects

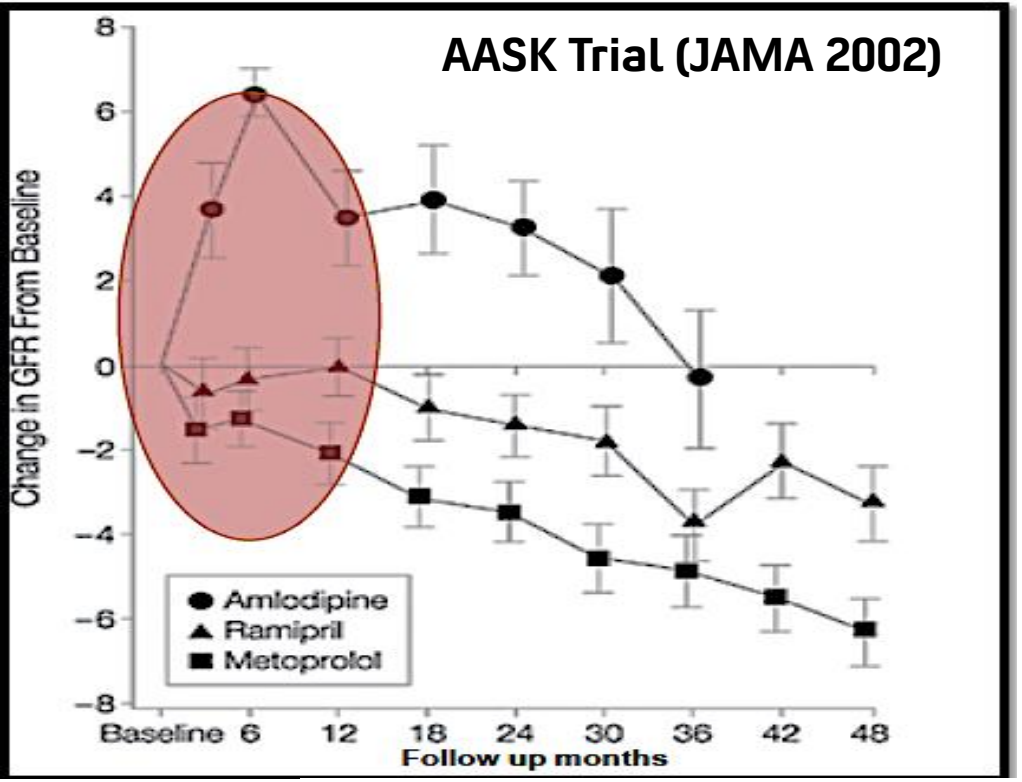


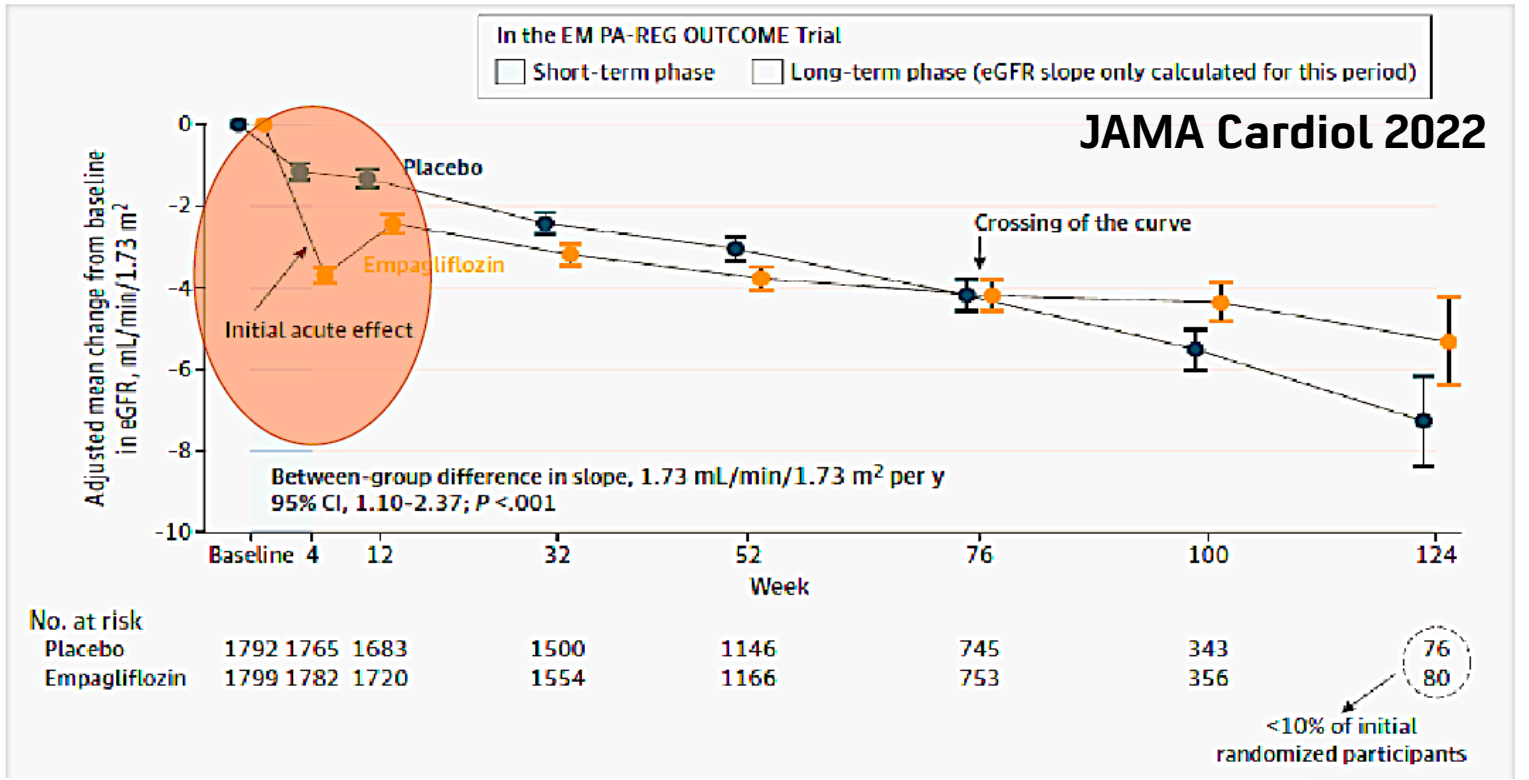
Increased hyperkalemia with minimal impact

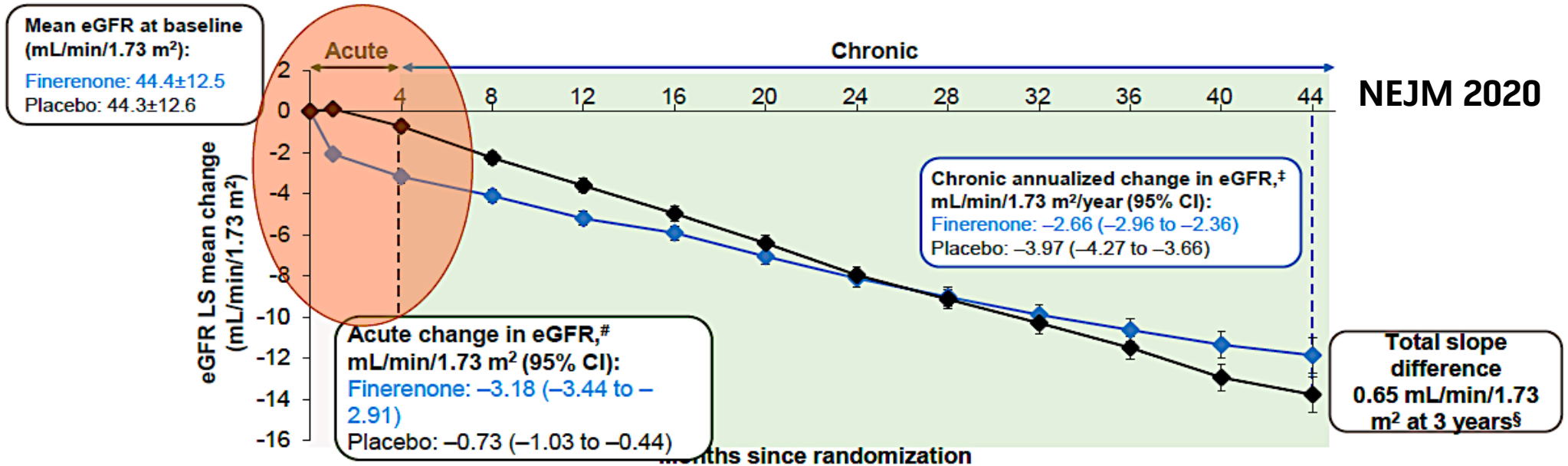


SBP = systolic blood pressure.

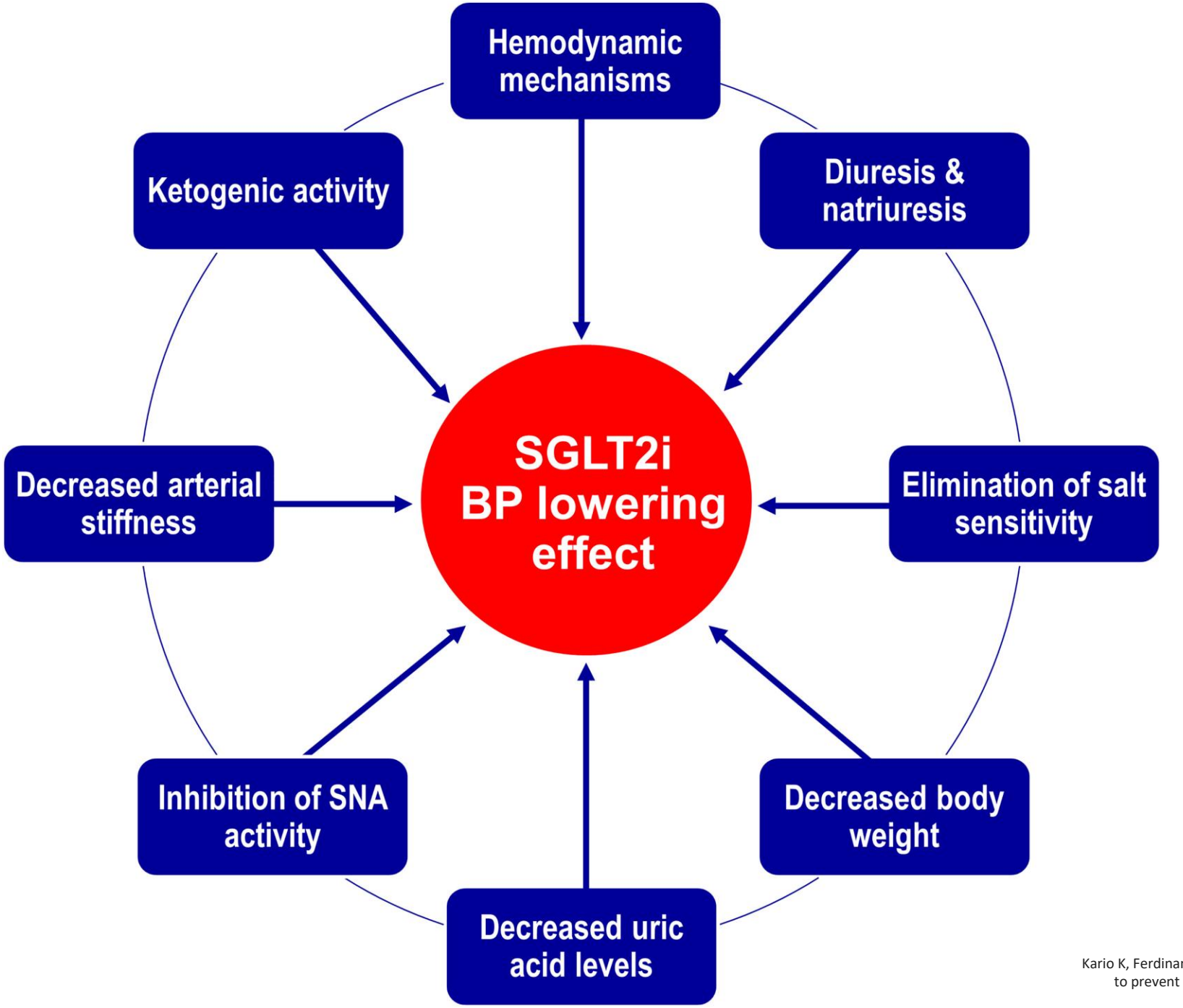
Agarwal R, et al. *Eur Heart J.* 2022;43:474-484 and supplement.







Bakris G and Weir M Am J Nephrol. 2022;53(7):513-515



Modest BP reduction with SGLT-2 inhibitor

SBP↓ 2.5-5 mmHg

Kario K, Ferdinand KC, O'Keefe JH. Control of 24-hour blood pressure with SGLT2 inhibitors to prevent cardiovascular disease. Prog Cardiovasc Dis. 2020 May-Jun;63(3):249-262.

Take Home Points

- Target BP <130/80 mmHg for most patients
- Order a 24-hour ABPM, if possible, to augment home BPs
- Incorporate systematic home BPs into your practice
- Lifestyle Modification always first
- Use A (ACE-i/ARB), C (CCB), D (Thiazide Diuretic) therapy
- Consider SGLT-2 inhibitors for BP management

Brigham and Women's Hospital
Founding Member, Mass General Brigham

THANK YOU!