

# Hypertension 2018

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# Introduction

- Clinical Consultant for DDTP and CCC for IHS.
- Board certified cardiologist.

# Disclosures

- No financial disclosures

# Outline

- Hypertension-overview
- 2017 ACC/AHA guidelines
- Evidence behind guidelines
- 2018 ADA HTN SOC
- Case studies

# Objectives

- Describe the importance of understanding clinical practice guidelines and application to individual patient treatment.
- Outline a plan for assessing patients for hypertension.
- Integrate the IHS Hypertension Treatment protocol into clinical care.
- Identify one change you can make in your clinical or public health practice.

# Evidence Grading System

## A

- Clear evidence from well-conducted, generalized RCTs, that are adequately powered, including:
  - Evidence from a well-conducted multicenter trial or meta-analysis that incorporated quality ratings in the analysis;
  - Compelling nonexperimental evidence;
  - Supportive evidence from well-conducted RCTs that are adequately powered

## B

- Supportive evidence from a well-conducted cohort studies
- Supportive evidence from a well-conducted case-control study

## C

- Supportive evidence from poorly controlled or uncontrolled studies\
- Conflicting evidence with the weight of evidence supporting the recommendation

## E

- Expert consensus or clinical experience

# Applying Class of Recommendation and Level of Evidence to Clinical Strategies, Interventions, or Treatments, or Diagnostic Testing in Patient Care\* (Updated August 2015)

CLASS (STRENGTH) OF RECOMMENDATION	LEVEL (QUALITY) OF EVIDENCE‡
<b>CLASS I (STRONG)</b> Benefit >>> Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> <li>Is recommended</li> <li>Is indicated/useful/effective/beneficial</li> <li>Should be performed/administered/other</li> <li>Comparative-Effectiveness Phrases †:               <ul style="list-style-type: none"> <li>Treatment/strategy A is recommended/indicated in preference to treatment B</li> <li>Treatment A should be chosen over treatment B</li> </ul> </li> </ul>	<b>LEVEL A</b> <ul style="list-style-type: none"> <li>High-quality evidence† from more than 1 RCT</li> <li>Meta-analyses of high-quality RCTs</li> <li>One or more RCTs corroborated by high-quality registry studies</li> </ul>
<b>CLASS IIa (MODERATE)</b> Benefit >> Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> <li>Is reasonable</li> <li>Can be useful/effective/beneficial</li> <li>Comparative-Effectiveness Phrases †:               <ul style="list-style-type: none"> <li>Treatment/strategy A is probably recommended/indicated in preference to treatment B</li> <li>It is reasonable to choose treatment A over treatment B</li> </ul> </li> </ul>	<b>LEVEL B-R (Randomized)</b> <ul style="list-style-type: none"> <li>Moderate-quality evidence‡ from 1 or more RCTs</li> <li>Meta-analyses of moderate-quality RCTs</li> </ul>
<b>CLASS IIb (WEAK)</b> Benefit ≥ Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> <li>May/might be reasonable</li> <li>May/might be considered</li> <li>Usefulness/effectiveness is unknown/unclear/uncertain or not well established</li> </ul>	<b>LEVEL B-NR (Nonrandomized)</b> <ul style="list-style-type: none"> <li>Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies</li> <li>Meta-analyses of such studies</li> </ul>
<b>CLASS III: No Benefit (MODERATE)</b> Benefit = Risk <i>(Generally, LOE A or B use only)</i> Suggested phrases for writing recommendations: <ul style="list-style-type: none"> <li>Is not recommended</li> <li>Is not indicated/useful/effective/beneficial</li> <li>Should not be performed/administered/other</li> </ul>	<b>LEVEL C-LD (Limited Data)</b> <ul style="list-style-type: none"> <li>Randomized or nonrandomized observational or registry studies with limitations of design or execution</li> <li>Meta-analyses of such studies</li> <li>Physiological or mechanistic studies in human subjects</li> </ul>
<b>CLASS III: Harm (STRONG)</b> Risk > Benefit Suggested phrases for writing recommendations: <ul style="list-style-type: none"> <li>Potentially harmful</li> <li>Causes harm</li> <li>Associated with excess morbidity/mortality</li> <li>Should not be performed/administered/other</li> </ul>	<b>LEVEL C-EO (Expert Opinion)</b> Consensus of expert opinion based on clinical experience

COR and LOE are determined independently (any COR may be paired with any LOE).

A recommendation with LOE C does not imply that the recommendation is weak. Many important clinical questions addressed in guidelines do not lend themselves to clinical trials. Although RCTs are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

\* The outcome or result of the intervention should be specified (an improved clinical outcome or increased diagnostic accuracy or incremental prognostic information).

† For comparative-effectiveness recommendations (COR I and IIa; LOE A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.

‡ The method of assessing quality is evolving, including the application of standardized, widely used, and preferably validated evidence grading tools; and for systematic reviews, the incorporation of an Evidence Review Committee.

COR indicates Class of Recommendation; EO, expert opinion; LD, limited data; LOE, Level of Evidence; NR, nonrandomized; R, randomized; and RCT, randomized controlled trial.

# CDC

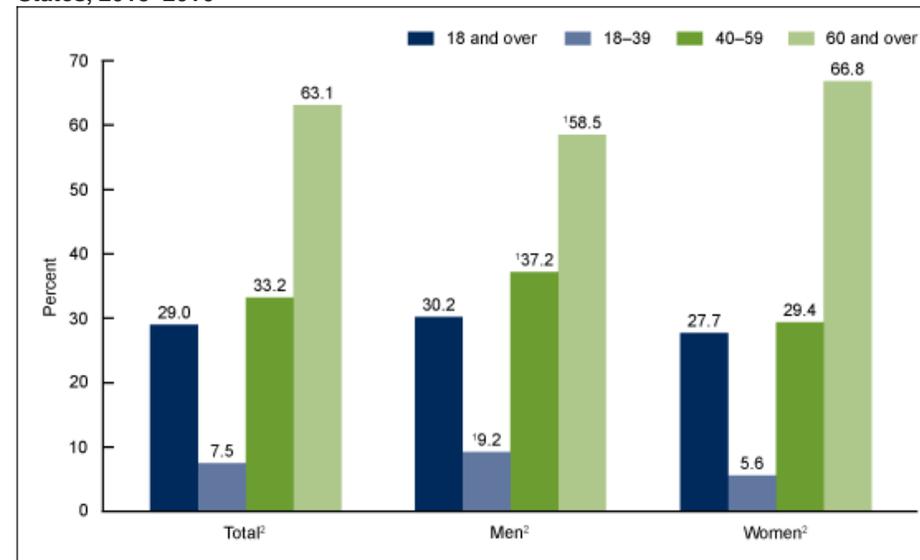
- **About 75 million** American adults (32%) have high blood pressure—that's **1 of every 3** adults.<sup>1</sup>
- Only **about half (54%)** of people with high blood pressure have their condition under control.<sup>1</sup>
- High blood pressure costs the nation **\$48.6 billion each year**. This total includes the cost of health care services, medications to treat high blood pressure, and missed days of work.<sup>2</sup>

1. Merai R, Siegel C, Rakotz M, Basch P, Wright J, Wong B; DHSc., Thorpe P. CDC Grand Rounds: A Public Health Approach to Detect and Control Hypertension. MMWR Morb Mortal Wkly Rep. 2016 Nov 18;65(45):1261-1264

2. Mozaffarian D, Benjamin EJ, Go AS, et al. Heart Disease and Stroke Statistics-2015 Update: a report from the American Heart Association. Circulation. 2015;e29-322

# Prevalence of Hypertension Among Adults aged 18 and over, by sex and age: United States, 2015 - 2016

Figure 1. Prevalence of hypertension among adults aged 18 and over, by sex and age: United States, 2015–2016



<sup>1</sup>Men significantly different from women in the same age group.

<sup>2</sup>Significant increasing trend by age.

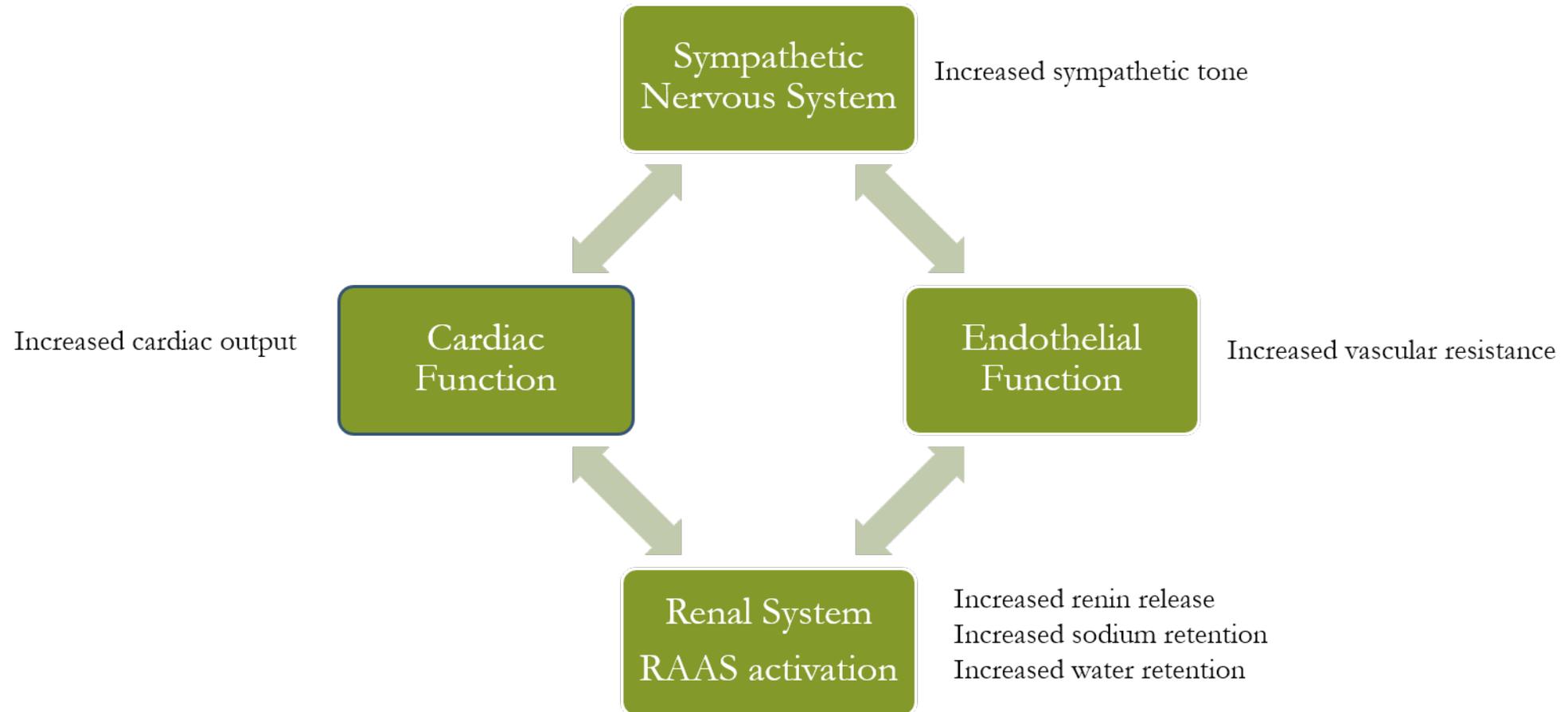
NOTES: Estimates for age group 18 and over are age adjusted by the direct method to the 2000 U.S. Census population using age groups 18–39, 40–59, and 60 and over. Crude estimates for age group 18 and over are 32.1%, total; 31.8%, men; and 32.4%, women. [Access data table for Figure 1.](#)

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2015–2016.

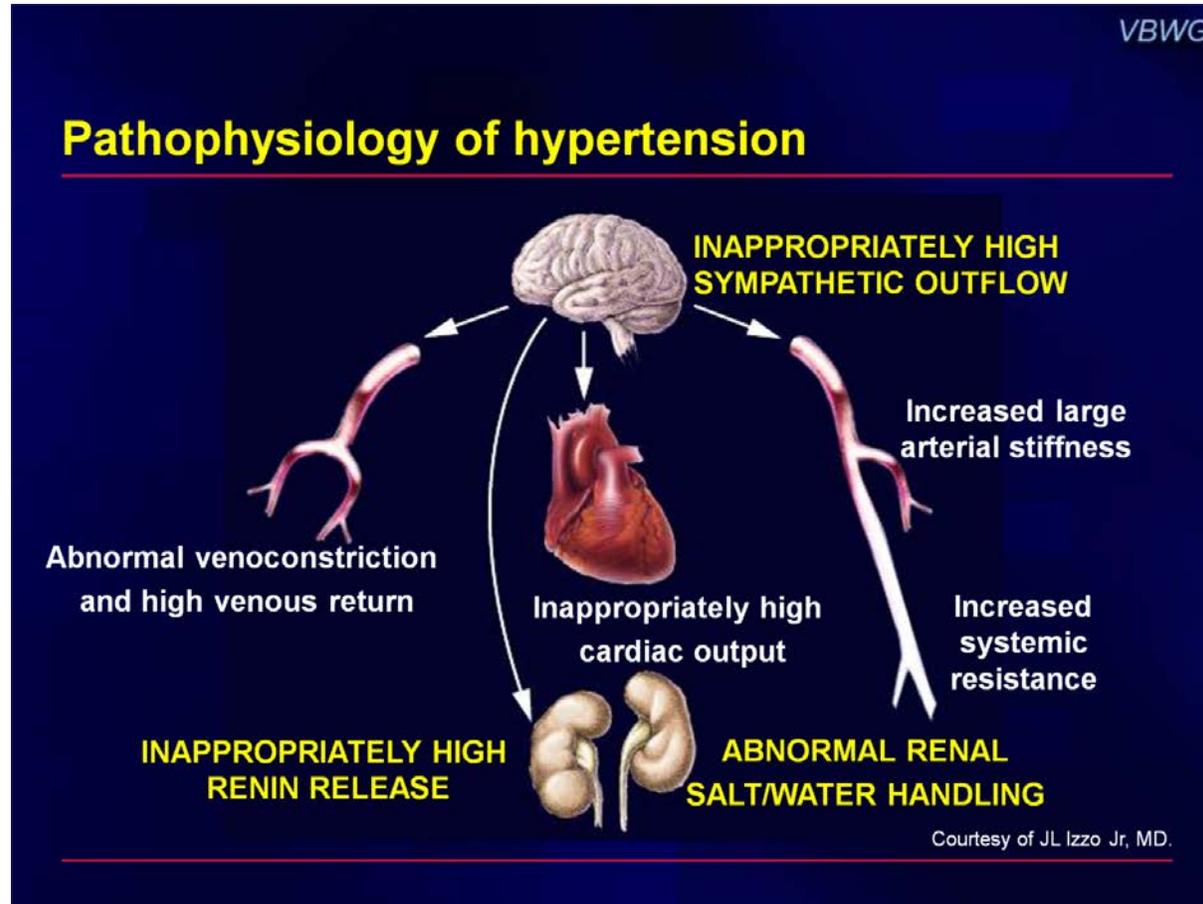
# What is Hypertension?

- High blood pressure
- The force exerted against the blood vessels as blood is being pumped from the heart to the body.  $\text{Cardiac output} \times \text{total vascular resistance}$ .
- Factors affecting blood pressure include the amount of blood being pumped, the strength of the heart pushing the blood out, the resistance of the vessels carrying the blood, and the width(flow) of the vessels.
- At what number is that “force” considered high?

# Pathogenesis of HTN



# Pathophysiology of Hypertension



# Pathogenesis of HTN

## **Increased cardiac output**

- Stress
  - Sympathetic activation
- Hypervolemia
  - Renal artery stenosis
  - Renal disease
  - Hyperaldosteronism
  - Hypersecretion of ADH

## **Increased systemic vascular resistance**

- Atherosclerosis
- Renal artery disease
- Thyroid dysfunction
- Diabetes
  - Endothelial damage
- Stress
  - Sympathetic activation

# Guidelines – Which one is right?

The image displays a collage of overlapping PDF documents related to hypertension guidelines, illustrating the complexity of choosing the right one. The documents are:

- 2014 ACC/AHA Science Advisory Effective Approach to High Blood Pressure.pdf**: A clinical alert from the American College of Cardiology, titled "An Effective Approach to High Blood Pressure Control".
- Canadian HTN guidelines.pdf**: A document from the Canadian Hypertension Society.
- HTN CPG 2017.pdf**: A document by Whelton PK, et al., titled "2017 High Blood Pressure Guideline for the...".
- ADA SOC 9 Cardiovascular Risk.pdf**: A document titled "9. Cardiovascular Disease and Risk Management: Standards of Medical Care in Diabetes—2018".
- JNC 8 Guidelines for the Management of High Blood Pressure.pdf**: A special communication titled "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)".

The documents are shown in various overlapping windows, highlighting the challenge of navigating multiple, sometimes conflicting, guidelines. The Windows taskbar at the bottom shows the system time as 1:34 PM on 1/8/2018.

Blue and Black?  
White and Gold?



# Targets for Systolic and Diastolic BP

Guideline	SBP target	DBP target	Rationale
JNC 8 (2014)	<140mmHg (grade E)	<90mmHg (grade E)	SBP target raised b/c “no RCTs have addressed whether treatment to SBP goal <140 compared with a higher goal improved health outcomes in adults with diabetes. DBP target raised b/c “there are no good or fair quality RCTs with mortality as a primary or secondary outcomes that compared a DBP goal of lower than 90 with a lower goal”.
ADA (2013-2017)	<140mmHg (grade A) <130mmHg (grade C)	<90mmHg (grade A) <80mmHg (grade C)	SBP target raised b/c “the evidence that SBP >140 is harmful is irrefutable but for some patients lower SBP targets closer to 130 are appropriate. DBP target raised b/c “strong evidence from RCT’s supports DBP of <90. Further “a DBP <80 may still be appropriate for pts with long life expectancy, CKD, CVD or additional risk factors.
Hypertension Canada (2017) and Diabetes Canada (2013)	<130mmHg (grade C)	<80mmHg (grade A) (grade B)	SBP target maintained: moving target to <140 may result in an increase in strokes based on the results from ACCORD-BP and meta-analysis of RCT’s DBP target maintained based on the HOT trial and the normotensive ABCD trial.
European Society of Hypertension (2013)	<140mmHg (level A)	<85mmHg (level A)	SBP target raised “there is no clear evidence of benefits in general from initiating tx at SBP levels <140 nor is there evidence of benefits from aiming at targets <130”. Supportive evidence against lowering SBP <130 comes from the ACCORD. DBP target raised b/c a “diastolic BP target between 80-85 is supported by the results of the HOT and UKPDS studies”.

# 2017 ACC/AHA Guidelines

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Kim Painter, Special for USA TODAY Published 4:19 p.m. ET Nov. 13, 2017 | Updated 7:58 a.m. ET Nov. 14, 2017

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About half of U.S. adults are now considered to have high blood pressure under new guidelines

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by MAGGIE FOX

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## Under New Guidelines, Millions More Americans Will Need to Lower Blood Pressure

By GINA KOLATA NOV 13, 2017



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HIGH BLOOD PRESSURE November 13th, 2017

## Half of US adults have high blood pressure in new guidelines

By ANAHEIM, Calif. | Associated Press



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# ACC 2017 Summary Table

Class	SBP	DBP	10yr ASCVD Risk <10%	10yr ASCVD Risk ≥10%	ASCVD secondary prevention
Normal	<120 mmHg	and <80 mmHg	Reassess 1 year	Lifestyle modification	Lifestyle modification
Elevated	120-129 mmHg	and <80 mmHg	Non-pharmacological intervention Reassess 3-6 months	Non-pharmacological intervention Reassess 3-6 months	Non-pharmacological intervention Reassess 3-6 months
Stage 1	130-139 mmHg	or 80-89 mmHg	Non-pharmacological intervention Reassess 3-6 months	Medical therapy and Non-pharmacological intervention Reassess 1 month	Medical therapy and Non-pharmacological intervention Reassess 1 month
Stage 2	≥140 mmHg	or ≥90 mmHg	Medical therapy and Non-pharmacological intervention Reassess 1 month	Medical therapy and Non-pharmacological intervention Reassess 1 month	Medical therapy and Non-pharmacological intervention Reassess 1 month

# Advance

- RCT, 11,140 pts, 4.3yr follow-up, T2D ages 30-55yr with risk for vascular disease, excluded well-controlled T2D and those on insulin.
- Active drug (indapamide) vs placebo. Active treatment resulted in mean BP of 136/73 vs 140/73.
- Composite endpoints: CV death, nonfatal MI, nonfatal stroke, new or worsening nephropathy or retinopathy.
- 9% RRR in MACE and 14% in total mortality.
- Pts randomized to active drug not different blood pressure goals.

# UKPDS-38

- RCT, 1,148 pts with HTN and T2D, 8.4yr follow up,
- Randomized to tight BP target <150/85mmHg vs less tight <180/105mmHg
- Outcomes: first clinical endpoint related to DM, death related to DM, death from all causes
- RRR 24% in DM related endpoints: 32% in DM related deaths: 44% in strokes and 37% in microvascular endpoints.
- Unable to separate SBP and DBP lowering effects.

# ACCORD-BP

- RCT 4,733 pts, T2D with A1C  $\geq 7.5$ ;  $\geq 40$  with CVD or  $\geq 55$  with high risk of CVD, 4.7 yr f/u.
- Randomized to intensive therapy SBP  $< 120$ mmHg vs standard therapy  $< 140$ mmHg.
- Nonfatal MI, nonfatal stroke or CV death.
- MACE similar in both groups; significant reduction in stroke 41% RRR, HR 0.59 balanced against greater risk of adverse drug events 3.3 vs 1.3.

# HOT

- HOT- RCT 1500 T2D with HTN defined as DBP 100-115mmHg, mean f/u 3.8yrs
- Randomized to DBP  $\leq 90$ mmHg,  $\leq 85$ mmHg, or  $\leq 80$ mmHg
- Outcomes: Major CV events, MI, Stroke, CV mortality and total mortality
- Decreased CV risk in diabetic patients with DBP  $\leq 80$  vs  $\leq 85$  vs  $\leq 90$
- DBP  $\leq 90$  resulted in increased risk of MACE compared to  $\leq 80$
- DBP  $\leq 80$  led to reduction in CV death compared to  $\leq 85$
- HOT: Slightly increased mortality in intensively treated diabetic patients with ischemic heart disease Lancet 1998;351:1755-62 and 1748-1749

# SPRINT

- SPRINT- RCT 9361 with SBP  $\geq 130$  but WITHOUT T2D
- Median f/u 3.26yrs
- Randomized to 120mmHg vs 140 mmHg
- Lower MACE in intensive treatment group 1.65% vs 2.19%. HR 0.75
- All cause mortality lower in intensive treatment group. HR 0.73
- Rates of adverse events not including injurious falls were higher in intensive treatment group

# People Excluded from SPRINT

- Diabetes
- Past stroke
- Clinical diagnosis of dementia, and/or being on dementia medication
- People residing in a nursing home. (Assisted-living was ok.)
- Substance abuse (active or within the past 12 months)
- Symptomatic heart failure within the past 6 months or left ventricular ejection fraction (by any method)  $< 35\%$
- Polycystic kidney disease or eGFR  $< 20$
- “Significant history of poor compliance with medications or attendance at clinic visits.”

# SPRINT BP Measurements

- Had people sit down and rest for five minutes before checking BP
- Checked BP three times consecutively, using an automated BP monitor (Omron 907)
- Used the average of those three BP measurements to assess the person's BP and determine whether medications should be adjusted up or down

# SPRINT NNT

- During follow-up, 1.65% per year of people in the intensive-treatment group and 2.19% per year of people in the standard-treatment experienced a significant cardiovascular “outcome event”: a heart attack, a stroke, acute decompensated heart failure, or death from cardiovascular causes.
- The study authors calculated that “The numbers needed to treat to prevent a primary outcome event, death from any cause, and death from cardiovascular causes during the median 3.26 years of the trial were 61, 90, and 172, respectively.”

# Randomized Controlled Trials of Intensive vs. Standard Hypertension Treatment Strategies

**Table 9.1—Randomized controlled trials of intensive versus standard hypertension treatment strategies**

Clinical trial	Population	Intensive	Standard	Outcomes
ACCORD BP (16)	4,733 participants with T2D aged 40–79 years with prior evidence of CVD or multiple cardiovascular risk factors	Systolic blood pressure target: <120 mmHg Achieved (mean) systolic/diastolic: 119.3/64.4 mmHg	Systolic blood pressure target: 130–140 mmHg Achieved (mean) systolic/diastolic: 133.5/70.5 mmHg	<ul style="list-style-type: none"> <li>No benefit in primary end point: composite of nonfatal MI, nonfatal stroke, and CVD death</li> <li>Stroke risk reduced 41% with intensive control, not sustained through follow-up beyond the period of active treatment</li> <li>Adverse events more common in intensive group, particularly elevated serum creatinine and electrolyte abnormalities</li> </ul>
ADVANCE BP (17)	11,140 participants with T2D aged 55 years and older with prior evidence of CVD or multiple cardiovascular risk factors	Intervention: a single-pill, fixed-dose combination of perindopril and indapamide Achieved (mean) systolic/diastolic: 136/73 mmHg	Control: placebo Achieved (mean) systolic/diastolic: 141.6/75.2 mmHg	<ul style="list-style-type: none"> <li>Intervention reduced risk of primary composite end point of major macrovascular and microvascular events (9%), death from any cause (14%), and death from CVD (18%)</li> <li>6-year observational follow-up found reduction in risk of death in intervention group attenuated but still significant (142)</li> </ul>
HOT (143)	18,790 participants, including 1,501 with diabetes	Diastolic blood pressure target: ≤80 mmHg	Diastolic blood pressure target: ≤90 mmHg	<ul style="list-style-type: none"> <li>In the overall trial, there was no cardiovascular benefit with more intensive targets</li> <li>In the subpopulation with diabetes, an intensive diastolic target was associated with a significantly reduced risk (51%) of CVD events</li> </ul>
SPRINT (144)	9,361 participants without diabetes	Systolic blood pressure target: <120 mmHg Achieved (mean): 121.4 mmHg	Systolic blood pressure target: <140 mmHg Achieved (mean): 136.2 mmHg	<ul style="list-style-type: none"> <li>Intensive systolic blood pressure target lowered risk of the primary composite outcome 25% (MI, ACS, stroke, heart failure, and death due to CVD)</li> <li>Intensive target reduced risk of death 27%</li> <li>Intensive therapy increased risks of electrolyte abnormalities and AKI</li> </ul>

CVD, cardiovascular disease; T2D, type 2 diabetes. Data from this table can also be found in the ADA position statement “Diabetes and Hypertension” (5).

# Guideline Recommendations

- Review 2018 ADA Standards of Care and 2017 ACC/AHA Hypertension guidelines
  - Definition
  - Measurement
  - Lifestyle modification
  - Pharmacological treatment

# Definition of High BP

COR	LOE	Recommendation for Definition of High BP
I	B-NR	BP should be categorized as normal, elevated, or stage 1 or 2 hypertension to prevent and treat high BP.

# 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.

# BP Goal for Patients With Hypertension

COR	LOE	Recommendations for BP Goal for Patients With Hypertension
I	SBP: B-R <sup>SR</sup>	For adults with confirmed hypertension and known CVD or 10-year ASCVD event risk of 10% or higher a BP target of less than 130/80 mm Hg is recommended.
	DBP: C- EO	
IIb	SBP: B-NR	For adults with confirmed hypertension, without additional markers of increased CVD risk, a BP target of less than 130/80 mm Hg may be reasonable.
	DBP: C- EO	

SR indicates systematic review.

# Hypertension/BP Control: Recommendations (2)

## Treatment Goals

- Most people with diabetes and hypertension should be treated to a systolic BP goal of <140 mmHg and a diastolic BP goal of <90 mmHg. **A**
- Lower systolic and diastolic BP targets, such as 130/80 mmHg, may be appropriate for individuals at high risk of CVD, if they can be achieved without undue treatment burden. **C**
- In pregnant patients with diabetes and preexisting hypertension who are treated with antihypertensive therapy, BP targets of 120-160/80-105 mmHg are suggested in the interest of optimizing long-term maternal health and minimizing impaired fetal growth. **E**

Cardiovascular Disease and Risk Management:  
*Standards of Medical Care in Diabetes - 2018. Diabetes Care* 2018; 41 (Suppl. 1): S86-S104

# Accurate Measurement of BP in the Office

COR	LOE	<b>Recommendation for Accurate Measurement of BP in the Office</b>
<b>I</b>	<b>C-EO</b>	For diagnosis and management of high BP, proper methods are recommended for accurate measurement and documentation of BP.

# Checklist for Accurate Measurement of BP

<b>Key Steps for Proper BP Measurements</b>
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.

# 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

# Hypertension/BP Control: Recommendations

## Screening and Diagnosis:

- Blood pressure (BP) should be measured at every routine clinical visit. Patients found to have elevated BP( $\geq 140/90$ ) should have BP confirmed using multiple readings, including measurements on a separate day, to diagnose hypertension. **B**
- All hypertensive patients with diabetes should monitor their BP at home. **B**

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# Out-of-Office and Self-Monitoring of BP

COR	LOE	Recommendation for Out-of-Office and Self-Monitoring of BP
I	A <sup>SR</sup>	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.

# Hypertension/BP Control: Recommendations (3)

## **Lifestyle Intervention**

- For patients with BP >120/80, lifestyle intervention consists of weight loss if overweight or obese; a Dietary Approaches to Stop Hypertension-style dietary pattern including reducing sodium and increasing potassium intake; moderation of alcohol intake; and increased physical activity. **B**

Cardiovascular Disease and Risk Management:  
Standards of Medical Care in Diabetes - 2018. Diabetes Care 2018; 41 (Suppl. 1): S86-S104

# Nonpharmacological Interventions

COR	LOE	Recommendations for Nonpharmacological Interventions
I	A	Weight loss is recommended to reduce BP in adults with elevated BP or hypertension who are overweight or obese.
I	A	A heart-healthy diet, such as the DASH (Dietary Approaches to Stop Hypertension) diet, that facilitates achieving a desirable weight is recommended for adults with elevated BP or hypertension.
I	A	Sodium reduction is recommended for adults with elevated BP or hypertension.
I	A	Potassium supplementation, preferably in dietary modification, is recommended for adults with elevated BP or hypertension, unless contraindicated by the presence of CKD or use of drugs that reduce potassium excretion.

# Nonpharmacological Interventions (cont.)

COR	LOE	Recommendations for Nonpharmacological Interventions
I	A	Increased physical activity with a structured exercise program is recommended for adults with elevated BP or hypertension.
I	A	Adult men and women with elevated BP or hypertension who currently consume alcohol should be advised to drink no more than 2 and 1 standard drinks* per day, respectively.

\*In the United States, 1 “standard” drink contains roughly 14 g of pure alcohol, which is typically found in 12 oz of regular beer (usually about 5% alcohol), 5 oz of wine (usually about 12% alcohol), and 1.5 oz of distilled spirits (usually about 40% alcohol).

# Best Proven Nonpharmacological Interventions for Prevention and Treatment of Hypertension\*

	Nonpharmacological Intervention	Dose	Approximate Impact on SBP	
			Hypertension	Normotension
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
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
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
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

\*Type, dose, and expected impact on BP in adults with a normal BP and with hypertension. DASH indicates Dietary Approaches to Stop Hypertension; and SBP, systolic blood pressure. Resources: Your Guide to Lowering Your Blood Pressure With DASH—How Do I Make the DASH? Available at: <https://www.nhlbi.nih.gov/health/resources/heart/hbp-dash-how-to>. Top 10 Dash Diet Tips. Available at: [http://dashdiet.org/dash\\_diet\\_tips.asp](http://dashdiet.org/dash_diet_tips.asp)

# Best Proven Nonpharmacological Interventions for Prevention and Treatment of Hypertension\* (cont.)

	Nonpharmacological Intervention	Dose	Approximate Impact on SBP	
			Hypertension	Normotension
Physical activity	Aerobic	<ul style="list-style-type: none"> <li>● 90–150 min/wk</li> <li>● 65%–75% heart rate reserve</li> </ul>	-5/8 mm Hg	-2/4 mm Hg
	Dynamic resistance	<ul style="list-style-type: none"> <li>● 90–150 min/wk</li> <li>● 50%–80% 1 rep maximum</li> <li>● 6 exercises, 3 sets/exercise, 10 repetitions/set</li> </ul>	-4 mm Hg	-2 mm Hg
	Isometric resistance	<ul style="list-style-type: none"> <li>● 4 × 2 min (hand grip), 1 min rest between exercises, 30%–40% maximum voluntary contraction, 3 sessions/wk</li> <li>● 8–10 wk</li> </ul>	-5 mm Hg	-4 mm Hg
Moderation in alcohol intake	Alcohol consumption	In individuals who drink alcohol, reduce alcohol† to: <ul style="list-style-type: none"> <li>● Men: ≤2 drinks daily</li> <li>● Women: ≤1 drink daily</li> </ul>	-4 mm Hg	-3 mm

\*Type, dose, and expected impact on BP in adults with a normal BP and with hypertension.

†In the United States, one “standard” drink contains roughly 14 g of pure alcohol, which is typically found in 12 oz of regular beer (usually about 5% alcohol), 5 oz of wine (usually about 12% alcohol), and 1.5 oz of distilled spirits (usually about 40% alcohol).

# Choice of Initial Medication

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

SR indicates systematic review.

# Hypertension/BP Control: Recommendations (5)

## Pharmacologic Interventions

- Treatment for hypertension should include drug classes demonstrated to reduce CV events in patients with diabetes: **A**
  - ACE Inhibitors
  - Angiotensin receptor blockers (ARBs)
  - Thiazide-like diuretics
  - Dihydropyridine calcium channel blockers

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# Choice of Initial Monotherapy Versus Initial Combination Drug Therapy

COR	LOE	<b>Recommendations for Choice of Initial Monotherapy Versus Initial Combination Drug Therapy*</b>
<b>I</b>	<b>C-EO</b>	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.
<b>Ila</b>	<b>C-EO</b>	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.

# Hypertension/BP Control: Recommendations (4)

## Pharmacologic Interventions

- Patients with confirmed office-based blood pressure  $\geq 140/90$  mmHg should, in addition to lifestyle therapy, have prompt initiation and timely titration of pharmacologic therapy to achieve BP goals. **A**
- Patients with confirmed office-based blood pressure  $\geq 160/100$  mmHg should, in addition to lifestyle therapy, have prompt initiation and timely titration of two drugs or a single-pill combination of drugs demonstrated to reduce CV events in patients with diabetes. **A**

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# Hypertension/BP Control: Recommendations (6)

## Pharmacologic Interventions

- Multiple-drug therapy is generally required to achieve BP targets. However, combinations of ACE inhibitors and ARBs and combinations of ACE inhibitors or ARBs with direct renin inhibitors should not be used. **A**

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# Diabetes Mellitus

COR	LOE	Recommendations for Treatment of Hypertension in Patients With DM
I	SBP: B-R <sup>SR</sup>	In adults with DM and hypertension, antihypertensive drug treatment should be initiated at a BP of 130/80 mm Hg or higher with a treatment goal of less than 130/80 mm Hg.
	DBP: C-EO	
I	A <sup>SR</sup>	In adults with DM and hypertension, all first-line classes of antihypertensive agents (i.e., diuretics, ACE inhibitors, ARBs, and CCBs) are useful and effective.
IIb	B-NR	In adults with DM and hypertension, ACE inhibitors or ARBs may be considered in the presence of albuminuria.

SR indicates systematic review.

# Hypertension/BP Control: Recommendations (7)

## Pharmacologic Interventions

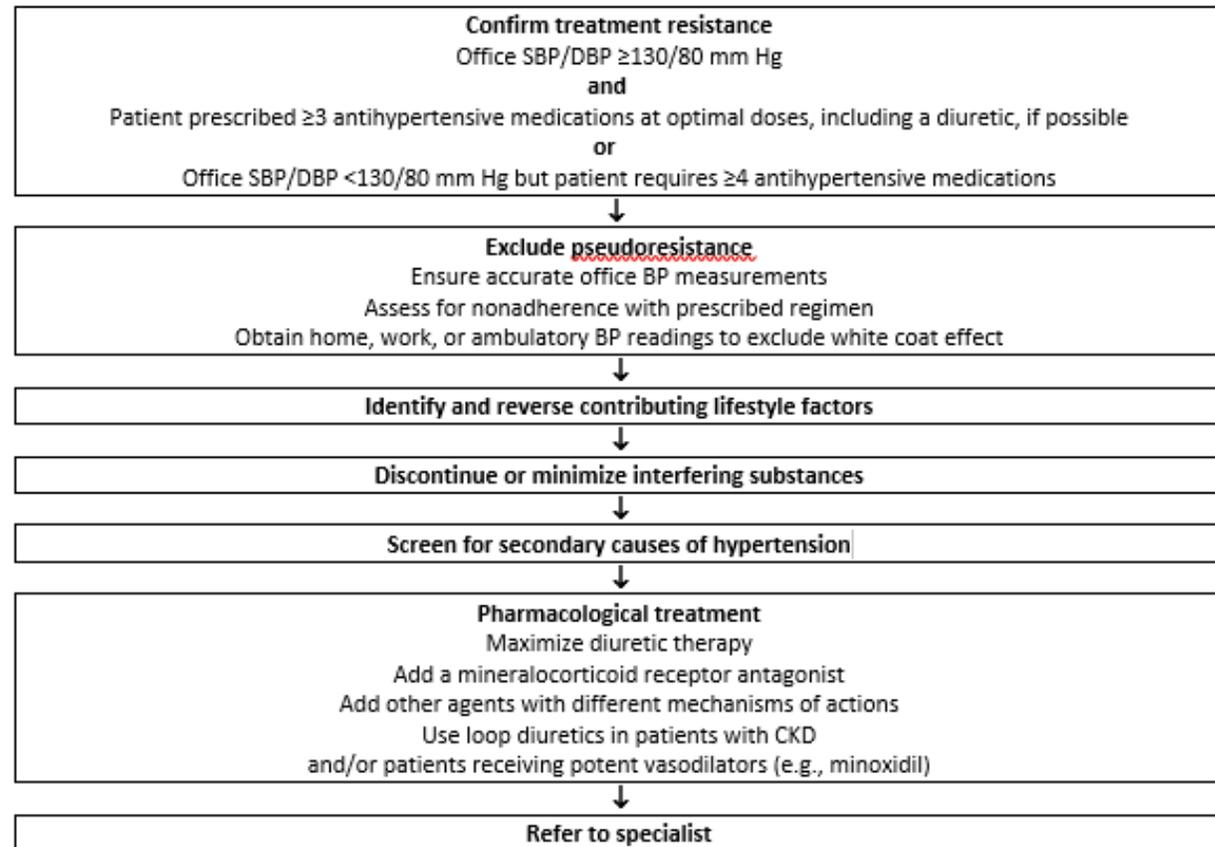
- An ACE inhibitor or ARB, at the maximumly tolerated dose indicated for BP treatment, is the recommended first-line treatment for hypertension in patients with diabetes and urinary albumin-to-creatinine ratio  $\geq 300$  mg/g creatinine A or 30-299 mg/g creatinine B. If one class is not tolerated, the other should be substituted. **B**
- For patients treated with an ACE inhibitor, ARB, or diuretic, serum creatinine/estimated glomerular filtrated rate and serum potassium levels should be monitored at least annually. **B**

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# Resistant Hypertension: Diagnosis, Evaluation, and Treatment

Figure 10. Resistant Hypertension: Diagnosis, Evaluation, and Treatment



BP indicates blood pressure; CKD, chronic kidney disease; DBP, diastolic blood pressure; eGFR, estimated glomerular filtration rate; NSAIDs, nonsteroidal anti-inflammatory drugs; and SBP, systolic blood pressure.

Adapted with permission from Calhoun et al.

# Hypertension/BP Control: Recommendations (8)

## **Resistant Hypertension**

- Patients with hypertension who are not meeting BP targets on three classes of antihypertensive medications (including a diuretic) should be considered for mineralocorticoid receptor antagonist therapy. **A**

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# Case 1

- 43 yo female with newly diagnosed T2D for routine f/u. No complaints.
- PMHX: Gestational DM, Asthma
- PSHX: Appy, C-section
- FHX: Father had high blood pressure and heart problems died age 60. Mother has heart problems and T2D.
- SHX: Works as a cashier. Drinks ETOH on weekends. Smokes tobacco when she drinks ETOH. No drugs. No routine exercise.

# Case 1

- Meds: Metformin 500mg BID, Simvastatin 40mg daily, Calcium supplement
- Allergies: PCN
- PE: Height-5'5" Weight-180lbs BMI- 30 BP: 145/89 P: 82
- Exam: unremarkable
- Labs: HbA1C: 6.8 previous 7.3, TC 180, HDL 45, LDL 135, all other labs within normal limits
- CVD Risk is 7.3% based on ASCVD risk calculator

# What would you do?

- Initiate non-pharmacologic therapy and medical therapy.
- Reassess 1 month and optimize as needed.

# Case 1

- BP 135/80
- CVD risk is now 6.3%
- What do you do now?
- Manage with non-pharmacologic therapy and reassess 3-6 mos

# Case 1

- Lipid profile: TC 230, HDL 40, LDL 180
- BP 135/80
- CVD risk is 11.8%
- What now?

# Case 1

- Initiate combination of non-pharmacologic therapy and medical therapy with follow up in 1 month.
- Consider increase in statin

# CVD Risk Factors Common in Patients With Hypertension

Modifiable Risk Factors*	Relatively Fixed Risk Factors†
<ul style="list-style-type: none"><li>• Current cigarette smoking, secondhand smoking</li><li>• Diabetes mellitus</li><li>• Dyslipidemia/hypercholesterolemia</li><li>• Overweight/obesity</li><li>• Physical inactivity/low fitness</li><li>• Unhealthy diet</li></ul>	<ul style="list-style-type: none"><li>• CKD</li><li>• Family history</li><li>• Increased age</li><li>• Low socioeconomic/educational status</li><li>• Male sex</li><li>• Obstructive sleep apnea</li><li>• Psychosocial stress</li></ul>

\*Factors that can be changed and, if changed, may reduce CVD risk.

†Factors that are difficult to change (CKD, low socioeconomic/educational status, obstructive sleep apnea, cannot be changed (family history, increased age, male sex), or, if changed through the use of current intervention techniques, may not reduce CVD risk (psychosocial stress).

CKD indicates chronic kidney disease; and CVD, cardiovascular disease.

# Case 2

- 69 yo male with T2D presents for routine evaluation. c/o “not feeling good”. Pain in is knees and arms.
- PHX: HTN, CKD stage 2, COPD, BPH, Osteoarthritis
- PSHX: TKR x 2, hernia repair
- FHX: Mother and Father both deceased. “they had it all”
- SHX: Retired mechanic, lives alone near his son and daughter, stopped smoking age 49. Walks “as much as I can”. No routine exercise.

## Case 2

- Meds: Metformin 1000mg BID, Glipizide 10mg BID, ASA 81mg daily, Lisinopril 20mg BID, Atorvastatin 80mg daily, tamsulosin, tiotropium, albuterol, fluticasone
- PE: HT 5'8", WT 220lbs, BMI 33.4, BP 137/89, P 58
- Exam: unremarkable
- Labs: GFR 60, HbA1C 8.9, TC 120, HDL 35, LDL 65
- CVD risk is 35.8%

# Case 2

- What do you do?

# Assessing Blood Pressure

## Obtain Appropriate Blood Pressure (BP) Measurement

- 5 minutes of sitting with both feet on the floor and back supported
- Support the arm at heart level
- Ensure correct cuff size
- Do not talk immediately before or during measurement
- Measure BP in both arms

## Confirm Blood Pressure Measurements

- Obtain  $\geq 2$  readings on  $\geq 2$  visits
- Consider ambulatory\* or home blood pressure monitoring (HBPM)
- If using HBPM, ensure patient is instructed on proper technique

## Exclude white coat hypertension or masked hypertension

- Suspect white coat HTN IF:
  - SBP  $>140$  and  $<160$  or
  - DBP  $>90$  or  $<100$  or
  - Clinic BP readings are  $\geq 5$ - $10$  mmHg above goal on  $\geq 3$  agents
- Suspect masked HTN IF:
  - SBP 130-140 or DBP 85-90 and high clinic suspicion (e.g. LVH on ECG, CKD, etc.)

# Treatment Target Options

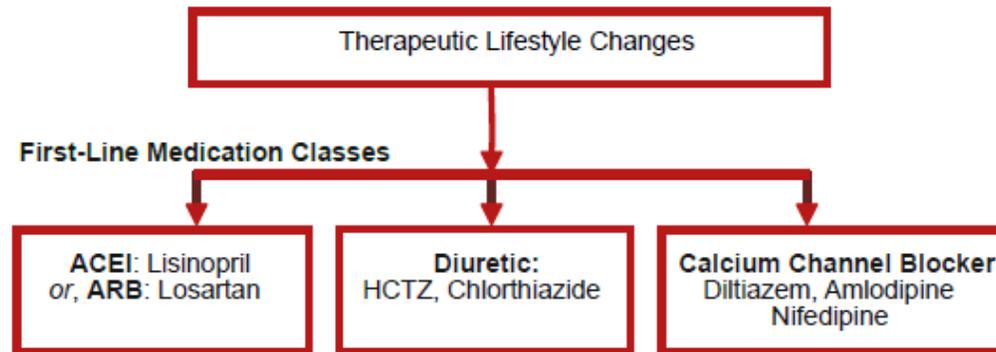
## Factors to Consider

Consider <130/80	<140/90	Consider <150/90
<ul style="list-style-type: none"><li>• Younger</li><li>• Healthier</li><li>• Low risk for hypotension</li><li>• Higher cardiovascular disease risk*</li><li>• Target is achievable without burdensome side effects</li></ul>	<ul style="list-style-type: none"><li>• MOST PATIENTS</li></ul>	<ul style="list-style-type: none"><li>• Older</li><li>• Multiple advanced comorbidities</li><li>• High risk for hypotension</li><li>• Polypharmacy</li><li>• Lower targets are unachievable due to side effects</li></ul>

\*High CVD risk is a 10-year atherosclerotic cardiovascular event risk of 10% or higher based on the 2013 ACC/AHA pooled cohort equation risk calculator.

# Hypertension Therapy in Type 2 Diabetes

## Hypertension Therapy in Type 2 Diabetes



*Consider ACEI or ARB as initial medication for patients with Chronic Kidney Disease  
Do not use an ACE Inhibitor and ARB together in the same patient.*

**If BP not at goal in one month, consider titrating dose up and/or adding medication from a different class above.** Utilize these 3 classes before considering additional medication classes.

### Consider Additional Medication Classes

If BP not at goal or unable to tolerate the first-line medication classes above, consider adding medications from additional drug classes. Base selection on individual patient indications.

**Mineralocorticoid**  
Spironolactone

**Beta Blocker**  
Metoprolol, Atenolol

**Alpha Blocker**  
Prazosin, Doxazosin

# Summary

- Individualize patient treatment
- Confirm accurate blood pressure measurements, especially if starting or changing medications.
- Use home blood pressure monitoring when possible

Questions?

Thank you!