

# **MANAGEMENT OF HYPERTENSION IN CHRONIC KIDNEY DISEASE- *Intensive or Standard Regimens?***

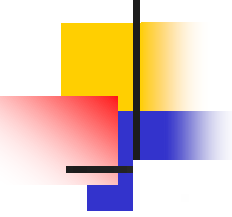
**Richard J. Glassock, MD, MACP**

***Professor Emeritus***

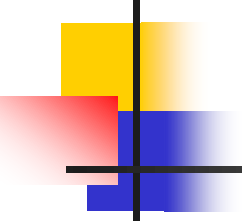
***Geffen School of Medicine at UCLA***

# **SPEAKER**

**Richard J. Glassock, MD, MACP, FRCP  
(Hon), FASN**



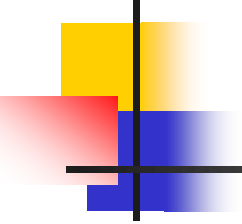
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- **Dr. Glassock is currently Professor Emeritus at the Geffen School of Medicine at UCLA. He has had a long standing interest in clinical nephrology (glomerular diseases) and hypertension and has published over 750 papers, books chapters and monographs. He is a former President of the ASN and NKF**



# DISCLOSURES

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- **Nothing to Disclose**



# LEARNING OBJECTIVES- *OUTLINE*

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- Hypertension as a *cause or consequence* of CKD
- The impact of intensive vs standard blood pressure control on *incident* CKD and its *progression* to ESKD
- *Clinical Practice Guidelines* for diagnosis/therapy of hypertension in CKD
- *Summary, Perspectives and Novel* approaches in development or in early stages of application

# Hypertension in CKD-

## *AXIOMS*

(see Carriazo S, et al Clin Kidney J 2020; 13:504-509; Agarwal R, NDT 2025; 40:1270-12729)

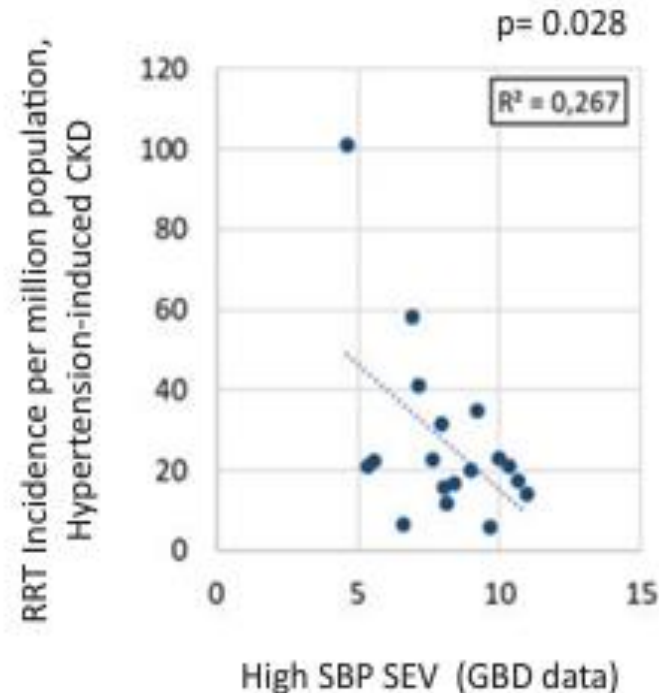
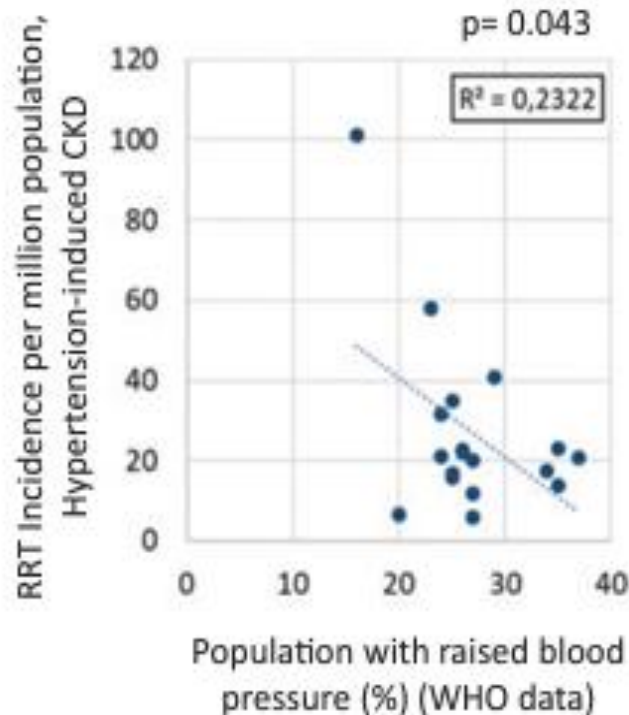
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- Elevated blood pressure is *very common* in CKD and tends to *worsen* as kidney function declines
- Hypertension is both *a cause and a consequence* of CKD (Bidirectional interaction)
- Non-malignant Hypertension is an *uncommon* cause of *incident* CKD but *likely* contributes to accelerating the rate of progression of established CKD
- Hypertension is *often* a manifestation of *underlying disease* causing CKD (e.g. Nephron under-endowment, APOL1 nephropathy, IgA Nephropathy, etc)
- Attribution of ESKD to "*hypertensive nephropathy*" is a nosologic/classification error conflating association with causation

# Hypertensive Nephropathy as a “cause” of Incident RRT compared to population prevalence of Hypertension

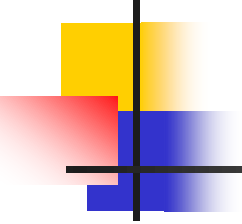
(from Carriazo S, et al CKJ 2020; 13:504-509)

**A** Inverse correlation of hypertension RRT with prevalence or burden of high blood pressure



# MAJOR PATHOGENIC FACTORS FOR ELEVATED BLOOD PRESSURE IN CKD

(See Ameer OZ- Frontiers in Pharmacology, 2022 for comprehensive Review)

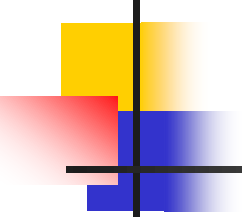
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- Salt retention and volume expansion (related to lower nephron mass- *congenital or acquired*)
  - Enhanced *sympathetic nervous system activity*
  - Incompletely suppressed *renin-angiotensin system*
  - *Relative Hyperaldosteronism*
  - *Endothelial dysfunction* (abnormal Nitric Oxide signalling)
  - Increased vascular stiffness (*collagen crosslinking/vascular calcification*). Mainly affects SBP and Pulse pressure



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**Blood Pressure Control**  
***(Intensive vs Standard)*** in  
**patients with and without**  
**CKD CKD**

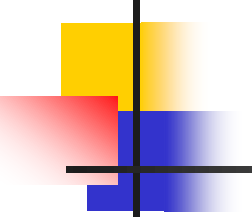




# MAJOR TRIALS of Intensive vs Standard BP Control

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- ***ACCORD BP* (2010)**- T2DM Diabetic- No reduction in CV events, more AE, Worse CKD
- ***SPRINT* (2015)**- Non-T2DM- Reduced CV but not in CKD. Worse CKD
- **STEP (2019)**- Lowered Stroke and HF, not specific for T2DM
- **ESPRIT (2024)** —Reduced CV death, MI Stroke and HF. Greater benefit in T2DM
- ***BPROAD* (2025)**-Reduced CV death. No effect on CKD progression, lower incident albuminuria



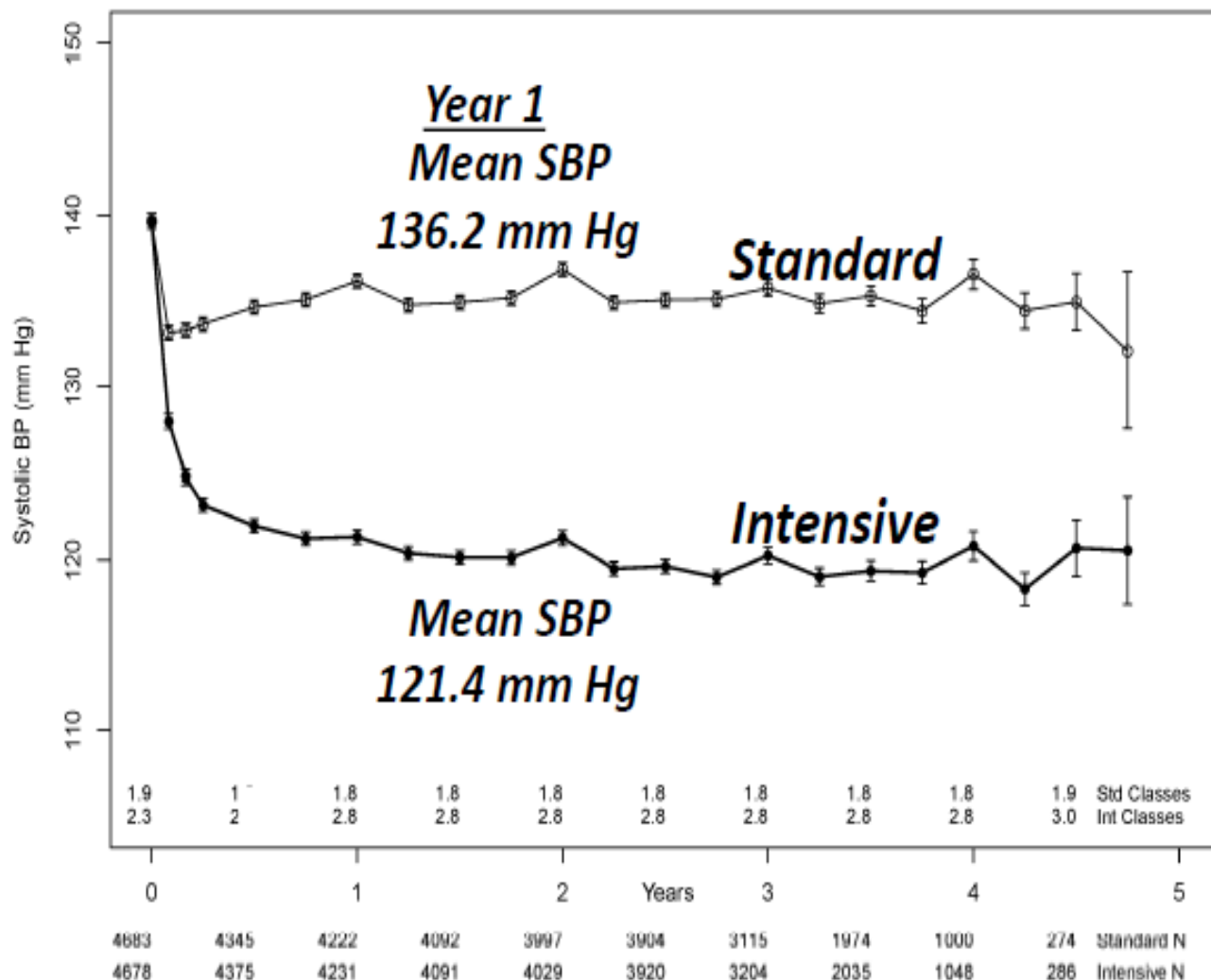
# SPRINT

(NEJM; November, 2015)

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- **9361** patients Randomized (4678-Intensive; 4683-Standard)
- **Non-Diabetic**; 91% already on anti-hypertensive treatment- mainly RASi- none on SGLT2i or MRA
- **CKD – 28%** (eGFR >20ml/min/1.73m<sup>2</sup>; uPER <1gm/d; average uACR- only 43mg/gm)
- Non-Hispanic Black- **30%**
- Average Age- **68 years** (28% ≥ 75 years)
- Pre-existing CVD- **22% (high risk population)**
- Follow-Up - **3.26** years- Stopped prematurely for Efficacy for **Composite CV** end point (not a study of Nephroprotection )

# Systolic BP During Follow-up

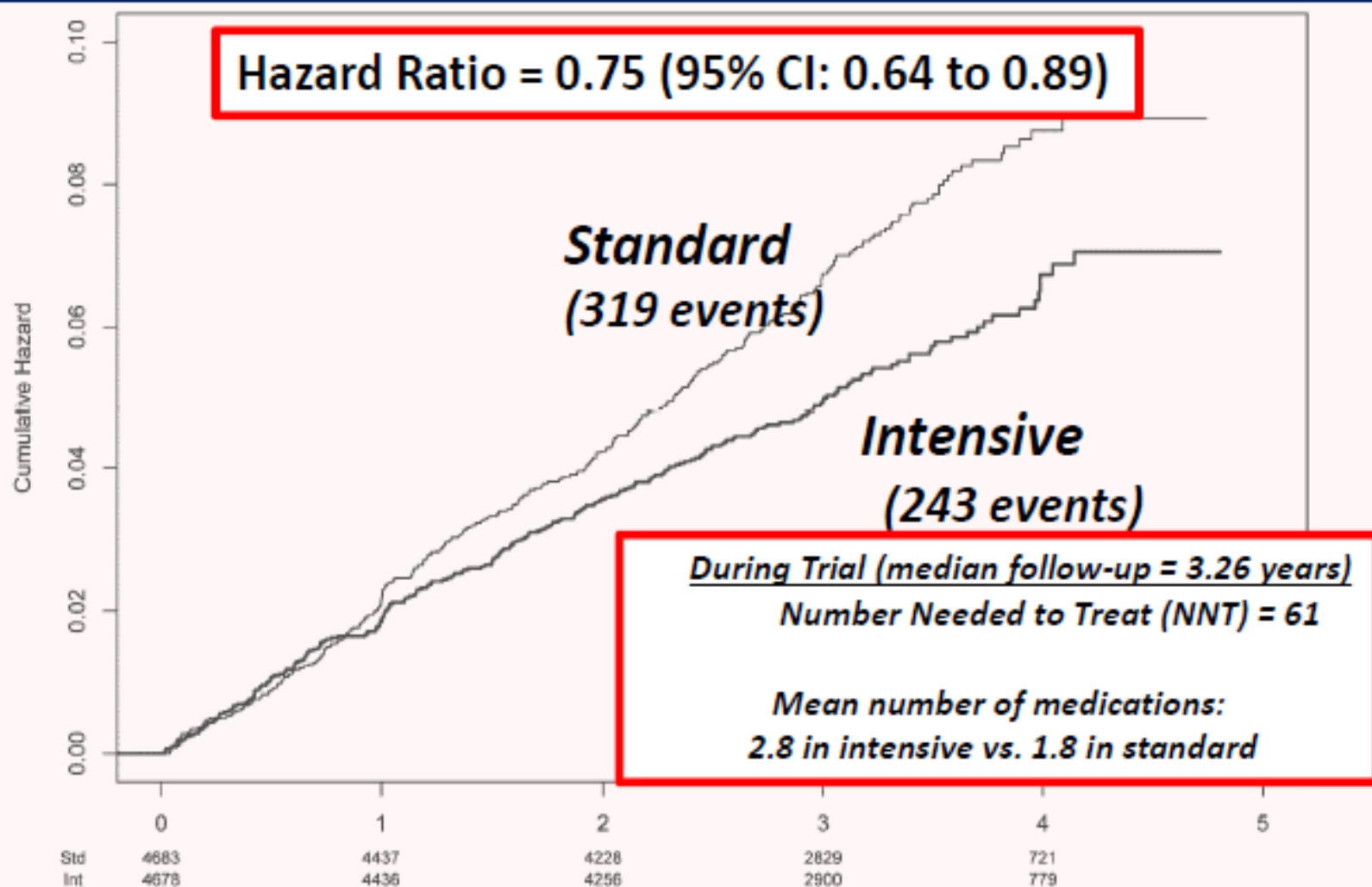


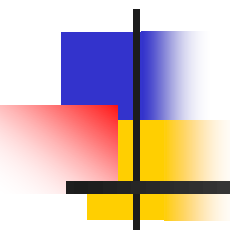
**Average  
SBP  
(During  
Follow-up)**

**Standard:  
134.6 mm Hg**

**Intensive:  
121.5 mm Hg**

# Primary Outcome (composite CV events)





# SPRINT

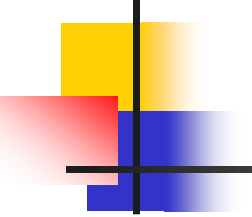
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## ***Renal Outcomes-***

**For patients with CKD at baseline  
(*n=2646*)- first occurrence of  
reduction of eGFR by 50% or more  
from BL, Dialysis or Transplantation**

# SPRINT:

## Renal Outcomes- in patients *with* CKD at BL



|                         | Intensive<br>(n=1330) | Standard<br>(n =1316) | Hazard Ratio |
|-------------------------|-----------------------|-----------------------|--------------|
| Composite Renal Outcome | 0.33%/yr              | 0.36%/yr              | 0.89 (ns)    |
| ≥50% decline in eGFR    | 0.23%/yr              | 0.26%/yr              | 0.87 (ns)    |
| Dialysis                | 0.14%/yr              | 0.24%/yr              | 0.57 (ns)    |
| Transplantation         | 0                     | 0                     | NA           |
| New Onset Albuminuria   | 3.02%/yr              | 3.90%/yr              | 0.72 (ns)    |

# SPRINT

## Renal Outcomes- in Patients *without* CKD at BL

|                                                                | Intensive<br>(n=3332)  | Standard<br>(n=3345)   | Hazard Ratio                                     |
|----------------------------------------------------------------|------------------------|------------------------|--------------------------------------------------|
| ≥30% decline in<br>eGFR to<br><60ml/min/1.73<br>m <sup>2</sup> | <b><i>1.21%/yr</i></b> | <b><i>0.35%/yr</i></b> | <b><i>3.49</i></b><br><b><i>(p&lt;0.001)</i></b> |
| New onset<br>albuminuria                                       | <b>2.00%/yr</b>        | <b>2.41%/yr</b>        | <b><i>0.81 (ns)</i></b>                          |

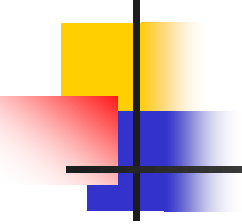
# Sub-Analysis of SPRINT for patient with CKD at BL

(Cheung AF, et al JASN 2017; 28:2812-2823- n= 2646)

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- **HR (at median FU of 3.3 years)  
Intensive vs Standard BP Control**
  - **Primary CVD end-point- *0.81 (ns)***  
**(95% CI= 0.63-1.05)**
  - **All cause Mortality- *0.72 (p<.05)***  
**(95% CI= 0.53-0.99)**
  - **Kidney Outcomes- *0.90 (ns)***  
**(95% CI= 0.44-1.83)**





# Long-Term (8.3 years) Follow-Up of SPRINT (an EHR analysis)

(Drawz P, et al CJASN, 2024)

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- **3041 participants (32% of the original cohort) in the SPRINT trial were FU via linkage to EHR for *8.3 years (Interventional (3.3 years) + observational (5.0 years))***

# Long Term Effects of Intensive BP Control on Kidney Function

(Drawz, PE et al CJASN, 2023)

Does intensive blood pressure control have a long-term effect on kidney function?

CJASN<sup>®</sup>  
Clinical Journal of the American Society of Nephrology



SPRINT data linked with EHR (electronic health record) data



3041 participants



8.3 years  
Median availability of EHR creatinine values



Intensive treatment  
vs  
Standard treatment



Intervention phase  
vs  
Observational phase  
Overall median follow-up 8.3 years

## Primary outcome

Standard Treatment  
Target systolic BP <140 mmHg  
1543

Intensive Treatment  
Target systolic BP <120 mmHg  
1498

Estimated eGFR at 8.3 years

63.8  
mL/min/1.73m<sup>2</sup>  
[62.2 to 63.4]

p<0.001

62.1  
mL/min/1.73m<sup>2</sup>  
[61.7 to 62.4]

Total slope of decline in eGFR in intervention phase

-0.67  
mL/min/1.73m<sup>2</sup>/year  
[-0.79 to -0.56]

p<0.001

-0.96  
mL/min/1.73m<sup>2</sup>/year  
[-1.08 to -0.85]

Post-trial slope of decline in eGFR in observational phase

-1.02  
mL/min/1.73m<sup>2</sup>/year  
[-1.24 to -0.81]

p=0.28

-0.85  
mL/min/1.73m<sup>2</sup>/year  
[-1.07 to -0.64]

## Secondary outcome

In participants **without** baseline CKD:  
Intensive treatment was associated with a higher risk of ≥30% eGFR decline during the intervention phase [HR 3.27 (2.43,4.40)] but not the observational phase [HR 1.13 (0.87,1.46)]

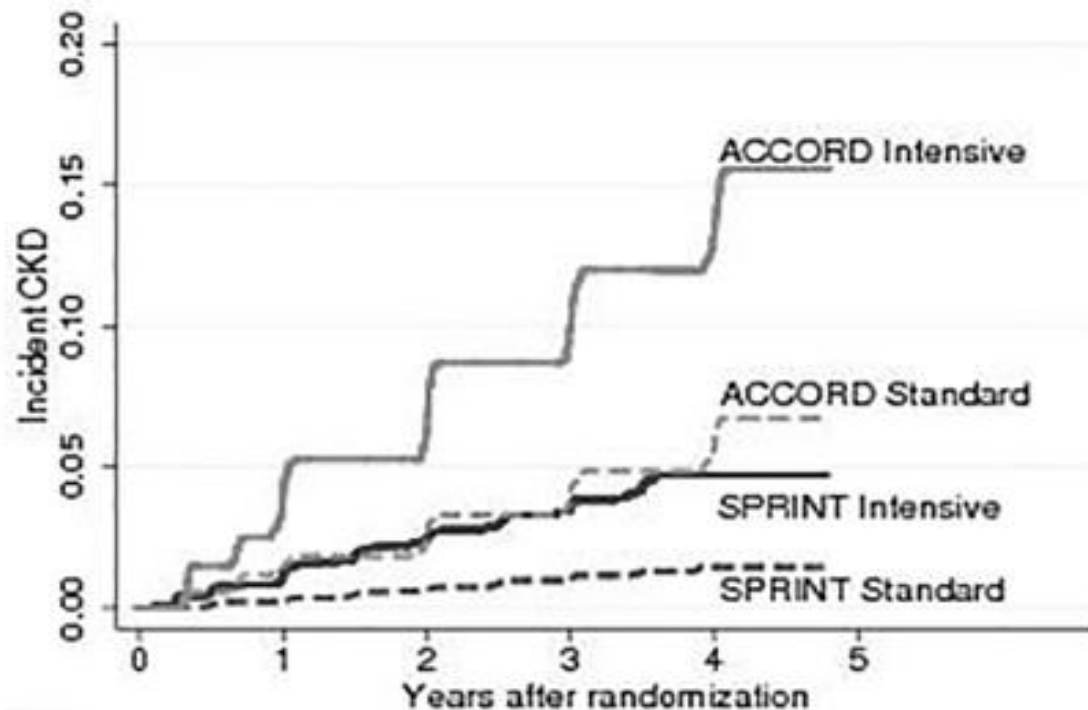
In participants **with** baseline CKD:  
Intensive treatment was associated with a higher risk of ≥50% eGFR decline eGFR or reaching end-stage kidney failure only during the intervention phase [HR 1.95 (1.03, 3.70)]

**Conclusions:** Intensive BP lowering was associated with a steeper total slope of decline in eGFR during the intervention phases of the trial, but not during post-trial long-term follow-up. The effects of intensive treatment on secondary kidney outcomes was similar.

Paul E. Drawz, Kristin M. Lenoir, Nayanjot Kaur Rai, et al. *Effect of Intensive Blood Pressure Control on Kidney Outcomes: Long-Term Electronic Health Record-Based Post-trial Follow-Up of SPRINT*. CJASN doi: 10.2215/CJN.0000000000000335. **Visual Abstract by Michelle Lim, MBChB, MRCP**

CLINICAL JOURNAL OF THE AMERICAN SOCIETY OF NEPHROLOGY

***SPRINT (non-Diabetic) AND ACCORD (Diabetic):***  
**A secondary analysis concerning the effect of BP control**  
**on *incident* CKD with and without T2DM**  
(Beddhu S, et al Lancet Diabetes and Endocrinol 2018; 6:555-563)

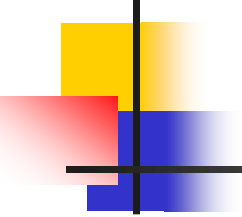


| Number at risk   |      |      |      |      |      |
|------------------|------|------|------|------|------|
| SPRINT Standard  | 3295 | 3224 | 3117 | 2133 | 525  |
| SPRINT Intensive | 3304 | 3186 | 3061 | 2089 | 500  |
| ACCORD Standard  | 2157 | 2041 | 1981 | 1874 | 1580 |
| ACCORD Intensive | 2148 | 1981 | 1872 | 1723 | 1388 |

# Intensive vs Standard BP Control in Type 2DM- *BPROAD Trial*

(Bi Y, et al NEJM 2025; 392:1155-1167)

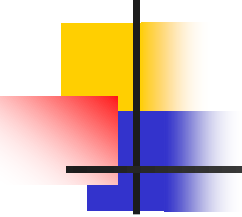
- *RCT trial* (in China) comparing intensive (<120mmHg SBP) to standard (<140mmHg DBP) in *12,821* patients with T2DM ( Median FU=4.2 years)
- *At BL*
  - eGFR<60ml/min/1.73m<sup>2</sup>= *7.6%*
  - UACR >30mg/gm= *38.5%*



# **BPROAD Trial**

## ***Composite CVD Outcomes***

| <b>Prior CKD</b> | <b>Intensive<br/>(Incidence<br/>Rate/ 100 Pt<br/>yrs)</b> | <b>Standard<br/>(Incidence<br/>Rate/ 100 Pt<br/>yrs)</b> | <b>Hazard Ratio</b>         |
|------------------|-----------------------------------------------------------|----------------------------------------------------------|-----------------------------|
| <b>NO</b>        | <b>5.9</b>                                                | <b>7.4</b>                                               | <b>0.79<br/>(0.69-0.71)</b> |
| <b>YES</b>       | <b>8.8</b>                                                | <b>11.7</b>                                              | <b>0.81<br/>(0.54-1.21)</b> |



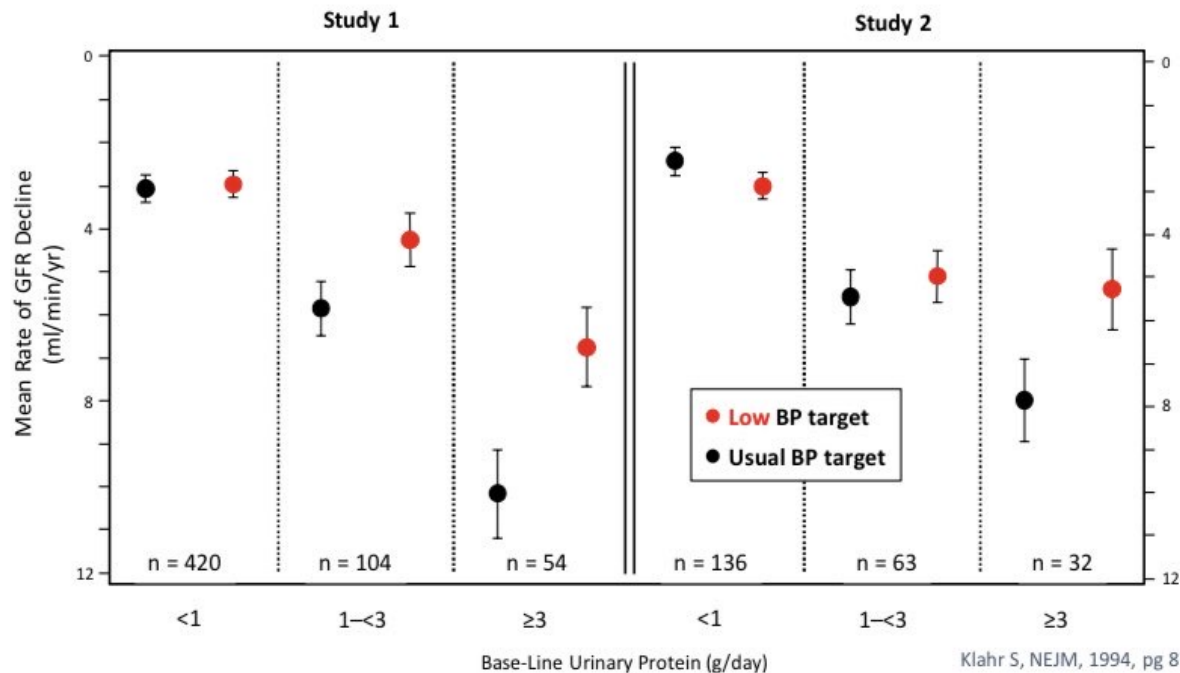
# BPROAD Trial- *CKD Outcomes*

|                         | Intensive<br>(Incidence<br>Rate/100 pt yrs) | Standard<br>(Incidence<br>Rate/100 pt yrs) | Hazard Ratio               |
|-------------------------|---------------------------------------------|--------------------------------------------|----------------------------|
| CKD<br>Progression      | 1.61                                        | 1.11                                       | 1.36<br>(0.71-2.69)        |
| CKD<br>Development      | 1.14                                        | 1.06                                       | 1.11<br>(0.92-1.34)        |
| Incident<br>Albuminuria | 11.29                                       | 13.84                                      | <i>0.87</i><br>(0.77-0.97) |

# INTENSIVE vs STANDARD BP CONTROL-

## *MDRD Study (NEJM, 1994)*

Effect of low BP target depends on  
baseline level of proteinuria



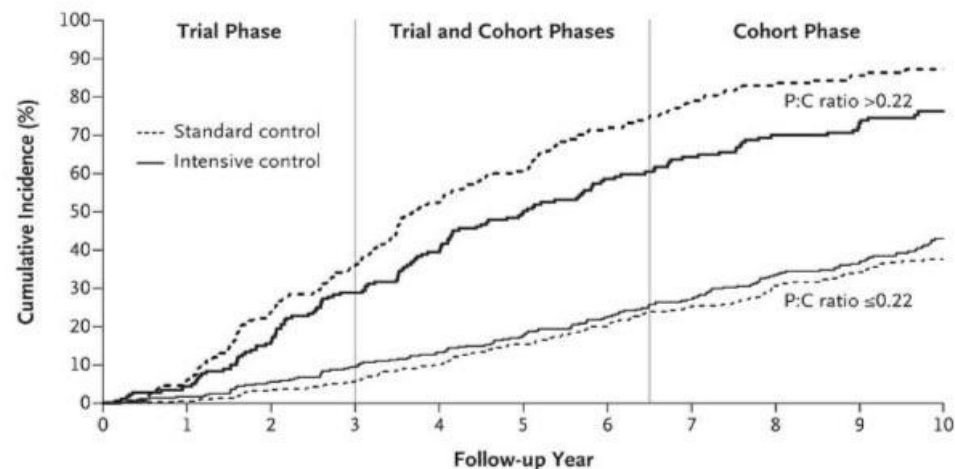
Klahr S, NEJM, 1994, pg 877.

# INTENSIVE vs STANDARD BP CONTROL-

## *AASK Trial (NEJM,2010)-Long Term FU*

(Appel LJ, et al. NEJM 2010; 363:918-929)

### AASK – Doubling of Cr, ESRD or Death According to Baseline Proteinuria Status



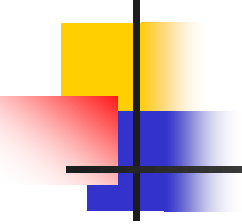
#### P:C Ratio >0.22

|                   |     |     |     |     |     |    |    |    |    |    |    |
|-------------------|-----|-----|-----|-----|-----|----|----|----|----|----|----|
| Standard control  | 176 | 165 | 134 | 113 | 81  | 66 | 45 | 32 | 26 | 22 | 13 |
| Intensive control | 181 | 172 | 151 | 128 | 109 | 87 | 67 | 56 | 47 | 40 | 25 |

#### P:C Ratio ≤0.22

|                   |     |     |     |     |     |     |     |     |     |     |     |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Standard control  | 376 | 373 | 362 | 353 | 332 | 302 | 267 | 234 | 214 | 196 | 128 |
| Intensive control | 357 | 350 | 335 | 321 | 306 | 282 | 254 | 228 | 206 | 189 | 128 |





# Seven Trials Analysis

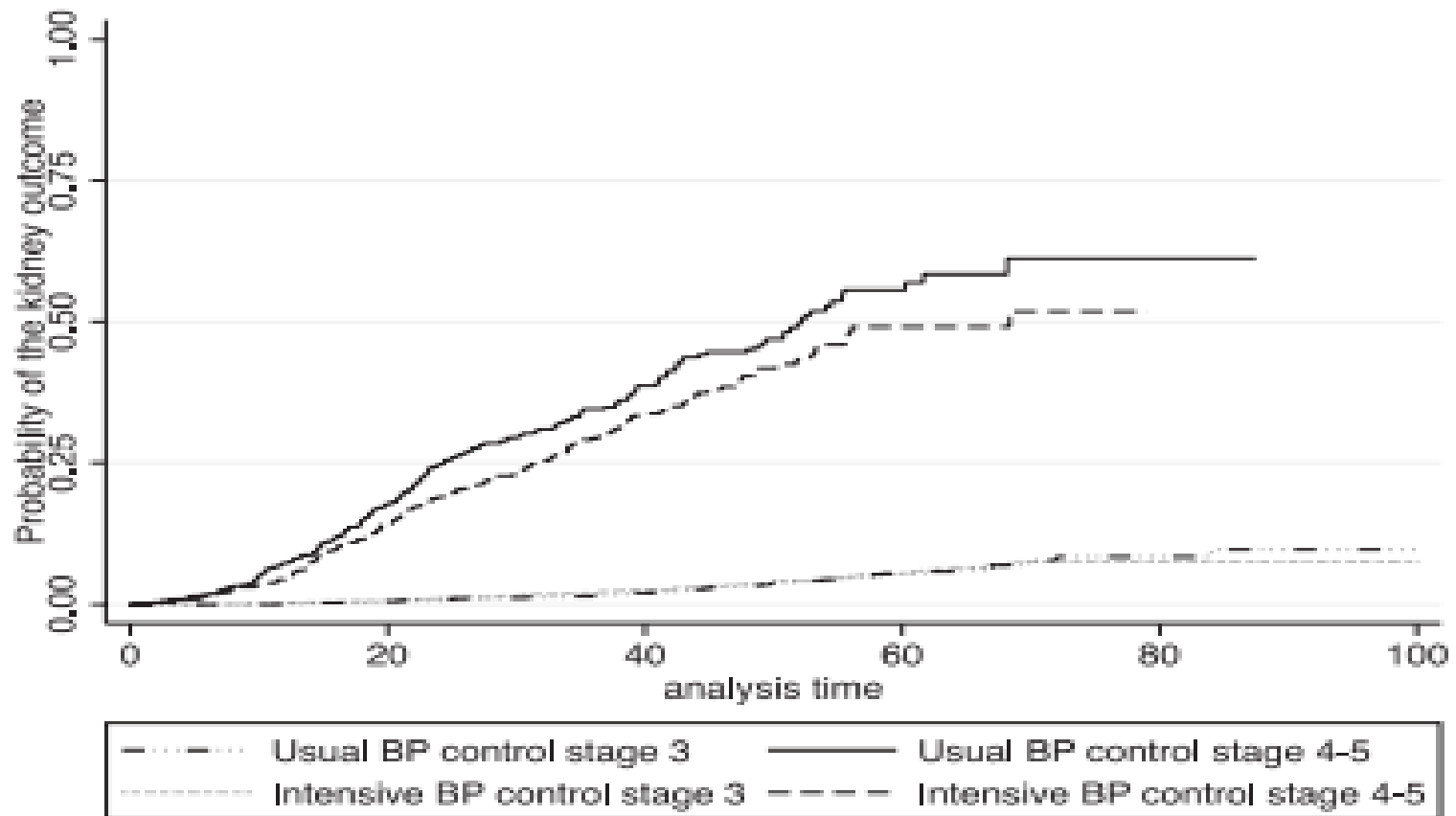
(Ku, E, et al JASN 2023; 34:385-393)

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- Pooled meta-analysis of 7 trials of CKD (eGFR  $<60\text{ml/min/1.73m}^2$ )- ***n=5823*** ; 12% with Diabetes; 30% A-A; BL eGFR=  $43\text{ml/min/1.73m}^2$
- Effect of ***Intensive BP control compared to usual control*** on the onset of kidney failure requiring KRT before death examined

# Seven Trials Analysis

(Ku, E, et al JASN 2023; 34:385-393)



# ADPKD- Intensive BP Control and Progression

(Brosnahan GM, et al and the HALT-PKD Investigators. Curr Hypertens Reviews. 2018; 14:39-47)

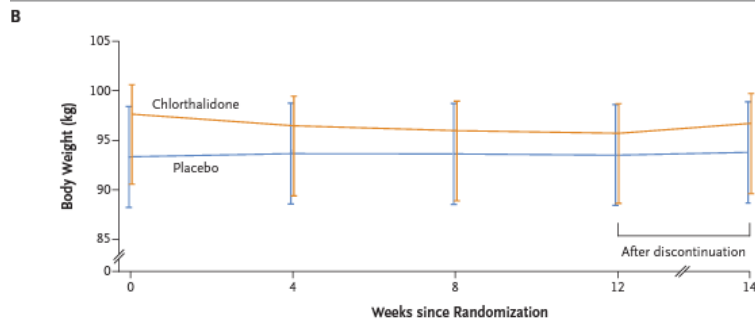
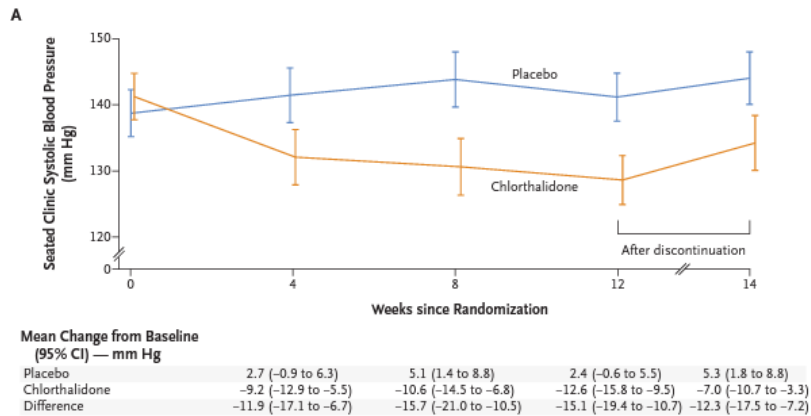
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- The ***HALT-PKD*** Trial showed a ***14%*** slower progression (Kidney Volume Growth/eGFR decline) when SBP was controlled (largely with RASi) of values of ***95-110mmHg***
- A ***post-hoc*** analysis showed that this effect was largely due to BP control and was ***not*** an effect of RASi dosage

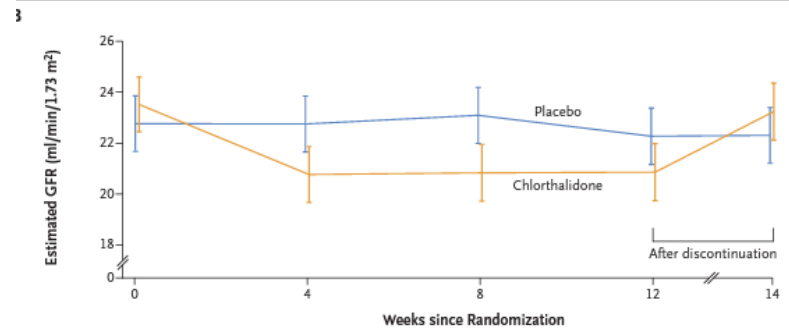
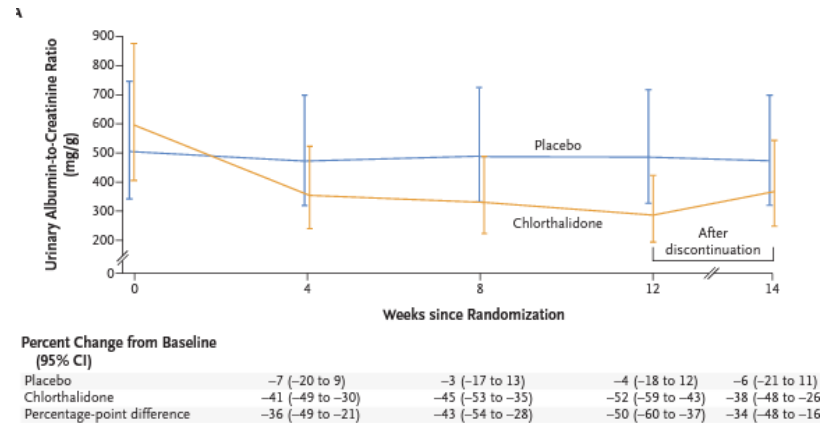
# Chlorthalidone in Advanced CKD (Stage 4)

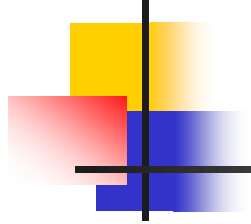
(CLICK study- Agarwal R, et al NEJM 2021; 385; 2507)

## SBP and BW

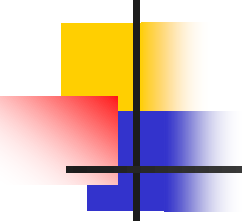


## UACR and eGFR





# **CLINICAL PRACTICE GUIDELINES FOR MANAGEMENT OF HYPERTENSION IN CKD PATIENTS**



# **ACC/AHA\* Guideline for Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults**

**(Whelton P, et al- 481 pages-Synopsis JAMA,  
November 2017)**

**(ACC, AHA, AAPA, ABC, ACPM, AGS/APHA, ASH, ASPC,  
NMA/PCNA- *No ASN, KDIGO, NKF, ACP or AAFP*  
*participation in development-* Consensus Driven)**

# Changes in BP Categories from JNC 7 to the New ACC/AHA Guideline

| SBP     |     | DBP   | JNC 7 2003           | 2017 ACC/AHA         |
|---------|-----|-------|----------------------|----------------------|
| <120    | and | <80   | Normal BP            | Normal BP            |
| 120–129 | and | <80   | Prehypertension      | Elevated BP          |
| 130–139 | or  | 80–89 | Prehypertension      | Stage 1 hypertension |
| 140–159 | or  | 90–99 | Stage 1 hypertension | Stage 2 hypertension |
| ≥160    | or  | ≥100  | Stage 2 hypertension | Stage 2 hypertension |

The categorization of BP should be based on the average of  $\geq 2$  readings on  $\geq 2$  occasions following a standardized protocol.

Adults with SBP and DBP in two categories are designated into the higher category.

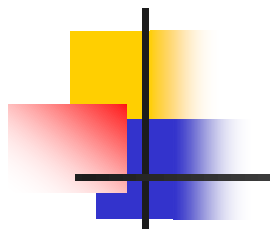
# Chronic Kidney Disease

| COR      | LOE                           | Recommendations for Treatment of Hypertension in Patients With CKD                                                                                                                          |
|----------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Strong   | <b>SBP:</b><br>Moderate*      | Adults with hypertension and CKD should be treated to a BP goal of less than 130/80 mm Hg.                                                                                                  |
|          | <b>DBP:</b><br>expert opinion |                                                                                                                                                                                             |
| Moderate | Moderate**                    | In adults with hypertension and CKD (stage 3 or higher or stage 1 or 2 with albuminuria $\geq$ 300 mg/d), treatment with an ACE inhibitor is reasonable to slow kidney disease progression. |
| Weak     | expert opinion                | In adults with hypertension and CKD (stage 3 or higher or stage 1 or 2 with albuminuria $\geq$ 300 mg/d), treatment with an ARB may be reasonable if an ACE inhibitor is not tolerated.     |



# AHA/ACC Guidelines:

## *Caveats*

- 
- Not endorsed by *ACP or AAFP* (yet)
  - Not applicable to practices using casual Office Based non-automated BP measurements
  - Largely based on Expert Opinion and Consensus
  - Ignores dangers of DBP <60-65mmHg in DM and CVD
  - In very low-risk subjects <140/90mmHg is a “reasonable” target
  - Do not apply to eGFR <20-30ml/min/1.73m<sup>2</sup> (CKD Category 4/5/5D)
  - Creates 31 Million new “hypertensives” (in the USA)- \$Billions of added costs and burden to PCP

# Hypertension in CKD:

## *European CPG*

(J Hypertension, June 2023)

| Hypertension disease staging | Other risk factors, HMOD, CVD or CKD    | BP (mmHg) grading                 |                               |                                 |                             |
|------------------------------|-----------------------------------------|-----------------------------------|-------------------------------|---------------------------------|-----------------------------|
|                              |                                         | High-normal SBP 130–139 DBP 85–89 | Grade 1 SBP 140–159 DBP 90–99 | Grade 2 SBP 160–179 DBP 100–109 | Grade 3 SBP ≥ 180 DBP ≥ 110 |
| Stage 1                      | No other risk factors <sup>a</sup>      | Low risk                          | Low risk                      | Moderate risk                   | High risk                   |
|                              | 1 or 2 risk factors                     | Low risk                          | Moderate risk                 | Moderate to high risk           | High risk                   |
|                              | ≥3 risk factors                         | Low to moderate risk              | Moderate to high risk         | High risk                       | High risk                   |
| Stage 2                      | HMOD, CKD grade 3, or diabetes mellitus | Moderate to high risk             | High risk                     | High risk                       | Very high risk              |
| Stage 3                      | Established CVD or CKD grade ≥4         | Very high risk                    | Very high risk                | Very high risk                  | Very high risk              |

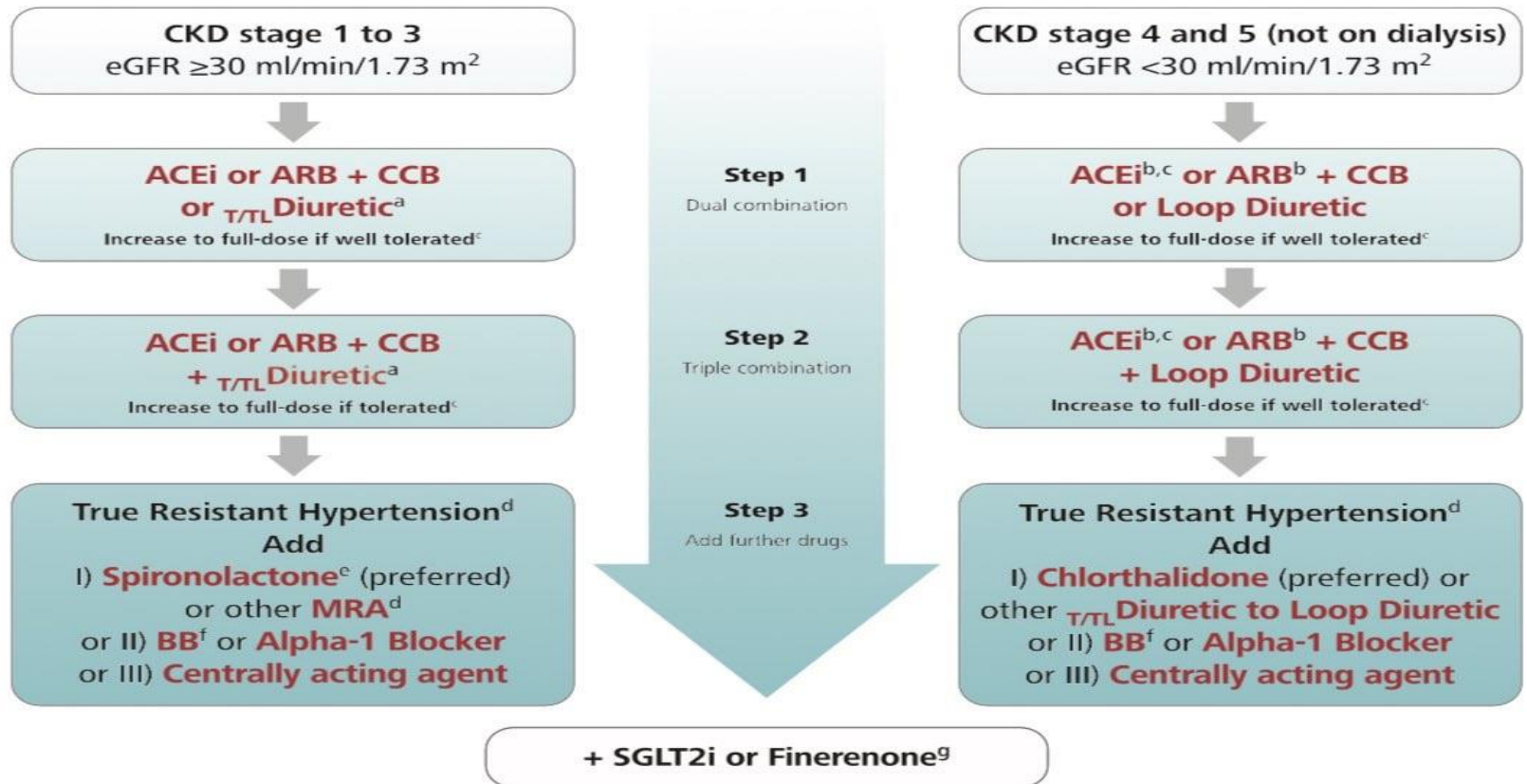
| <50 years    | 60–69 years | ≥70 years   |
|--------------|-------------|-------------|
| <2.5%        | <5%         | <7.5%       |
| 2.5 to <7.5% | 5 to <10%   | 7.5 to <15% |
| ≥7.5%        | ≥10%        | ≥15%        |

Complementary risk estimation in Stage 1 with SCORE2/SCOR2-OP

# Hypertension in CKD-

## *European CPG*

(J. Hypertension, June 2023)



# European Renal Association Synopsis of Guidelines for Hypertension Management in CKD- **2024**

(Sarafidis P, et al NDT, 2024)

- **Targets** – office based BP <140/90mmg in ALL; <130/80mmHg on young patients, those with UACR >300mg/gm; high CVD risk. ***A target of <120/80mmHg is not recommended***
- **Drugs**– ACEi/ARB ±CCB recommendede for initial therapy. Diabetics depending on eGFR. Spironolactone and/or chlorthalidone in selected patients
- **Other**- SGLT2i added for CVD and renoprotection if eGFR >20ml/min/1.73m2. ns- MRA in diabetics with increased UACR,[K<sup>+</sup>] <5mmol/L, eGFR >25ml/min/1.73m2

# KDIGO Practice Guidelines for Management of Blood Pressure in non-dialysis CKD

(KDIGO- 2021; KI Supplements 99:#35; s1-s85; abbreviated summary; Synopsis. Tomson CRV et al Ann Intern Med 2021; 174:1270-1281)

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## ■ ***"Standardized" office BP measurement recommended:***

- **Sitting, feet on floor, "relaxed" for 5 minutes**
- **Empty bladder**
- **No talking**
- **Clothing on upper arm removed**
- **Calibrated oscillo-metric device preferred; but calibrated auscultatory (Korotkoff sounds) aneroid device acceptable**
- **Cuff size appropriate to arm circumference**
- **At first visit, measure BP in both arms; use highest value**
- **Average of  $\geq 2$  readings on  $\geq 2$  visits**

# KDIGO Practice Guidelines for Management of Blood Pressure in CKD (2021)

(KDIGO- KI Supplements 99:#35; s1-s85;  
abbreviated summary)

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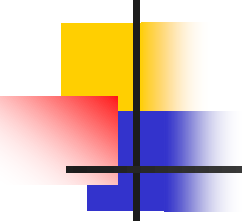
- ***Suggests*** that adult subjects (age above 18 years) with high BP (SBP= $\geq$ 130mmHg ) be treated to a target SBP of ***<120mmHg***, when tolerated using standardized office BP measurement (Evidence Level 2B)
- This suggestion is ***not dependent on etiology of CKD***. Except patients with ADPCKD who may derive benefits of SBP <120mmHg
- This target ***not recommended*** when BP measured by ***non-standardized methods***

# KDIGO Practice Guidelines for Management of Blood Pressure in CKD (2021)

(KDIGO- KI Supplements 99:#35; s1-s85;  
abbreviated summary)

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- ***Suggests*** that ***out-of-office*** BP measurements (Either ambulatory or home monitoring) be used to complement standardized office-based BP readings for management (2B).
- Patients should be classified as ***White Coat Hypertension, Masked Hypertension, Sustained Hypertension or Normotension*** based on the office and out-of-office recordings.



# KDIGO- CKD

## *Treatment modalities*

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- **RASi strongly preferred for non-diabetic subjects with G1-4/A3 CKD (1B)**
- **RASi strongly preferred for Diabetic subjects with G1-4/A2 or A3 CKD (1B)**
- **RASi weakly preferred for non- diabetic subjects with G1-4/A2 (2C)**



# KDIGO-CKD-BP Guidelines

## *Uncertainties concerning the balance of benefits and harms*

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- **Applicability to CKD Categories G4/G5 (G5D)**
- **Diabetic vs Non-Diabetic CKD**
- **Patients with SBP of 120-129mmHG**
- **Patients with very low DBP (<50mmHg)**
- **Etiology of CKD not important; except ADPKD who may derive renal benefits at SBP of 95-110mmHg**
- **Older age, frailty**
- **Patients at low risk of CVD**
- **“White –Coat” hypertension; Multi-drug resistant Hypertension**
- **Severe hypertension (SBP  $\geq$ 180mmHg)**

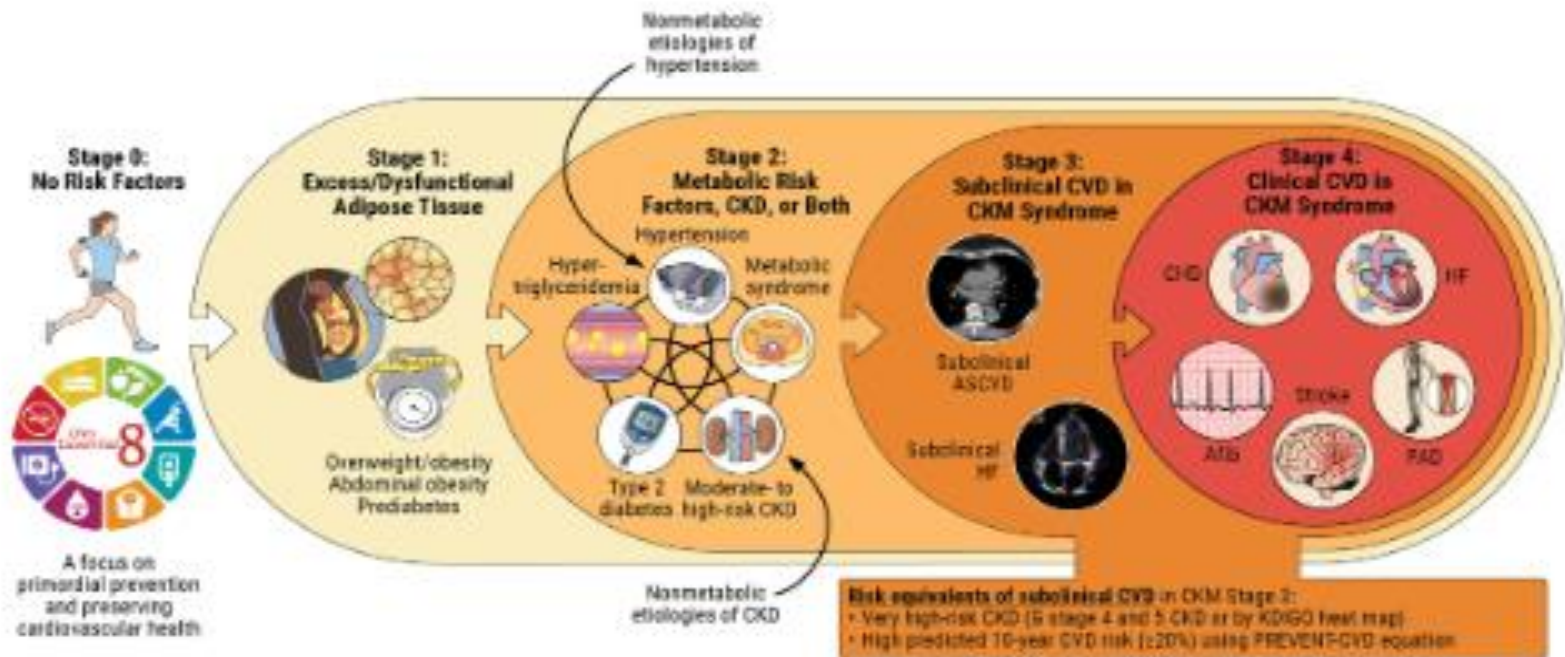
# CARDIOVASCULAR-KIDNEY-METABOLIC (CKM) SYNDROME

(Nkumele CE and AHA, ACC, ADA and ASN  
Circulation, 2026)

- ***Definition***- CKM syndrome is a health disorder due to connections among heart disease, kidney disease, diabetes, and obesity, leading to poor health outcomes.
- ***Components***- ASCVD (overt or subclinical), CHF (HfpEF/HFrEF), CKD (KDIGO classification), T2DM, Obesity (BMI >30kg/M<sup>2</sup>), Metabolic Syndrome, (H Dyslipidemia (High LDL/ApoB/low HDL), MASLD

# GUIDELINES for Management of Cardiovascular/Kidney/Metabolic(CKM) Syndrome- *Staging*

## Stages of CKM Syndrome



# CKM- CKD Heat Maps for Risk (KDIGO, 2024)

## Kidney Disease: Improving Global Outcomes (KDIGO) Heat Map for Classification of CKD Risk

| CKD is classified based on: <ul style="list-style-type: none"> <li>• Cause*</li> <li>• GFR</li> <li>• Albuminuria</li> </ul> |     |                                  |       | Albuminuria categories                               |                                                     |                                                |
|------------------------------------------------------------------------------------------------------------------------------|-----|----------------------------------|-------|------------------------------------------------------|-----------------------------------------------------|------------------------------------------------|
|                                                                                                                              |     |                                  |       | Description and range                                |                                                     |                                                |
|                                                                                                                              |     |                                  |       | A1                                                   | A2                                                  | A3                                             |
|                                                                                                                              |     |                                  |       | Normal to mildly increased<br><30 mg/g<br><3 mg/mmol | Moderately increased<br>30–299 mg/g<br>3–29 mg/mmol | Severely increased<br>≥300 mg/g<br>≥30 mg/mmol |
| GFR categories (mL/min/1.73 m <sup>2</sup> )<br>Description and range                                                        | G1  | Normal or high                   | ≥90   | Screen                                               | Treat                                               | Treat and refer                                |
|                                                                                                                              | G2  | Mildly decreased                 | 60–89 | Screen                                               | Treat                                               | Treat and refer                                |
|                                                                                                                              | G3a | Mildly to moderately decreased   | 45–59 | Treat                                                | Treat                                               | Treat and refer                                |
|                                                                                                                              | G3b | Moderately to severely decreased | 30–44 | Treat                                                | Treat and refer                                     | Treat and refer                                |
|                                                                                                                              | G4  | Severely decreased               | 15–29 | Treat and refer                                      | Treat and refer                                     | Treat and refer                                |
|                                                                                                                              | G5  | Kidney failure                   | <15   | Treat and refer                                      | Treat and refer                                     | Treat and refer                                |

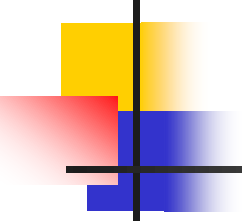
Low risk (if no other markers of kidney disease, no CKD)

Moderately increased risk

High risk

Very high risk





## CKM- Stage 2- *Hypertension Management*

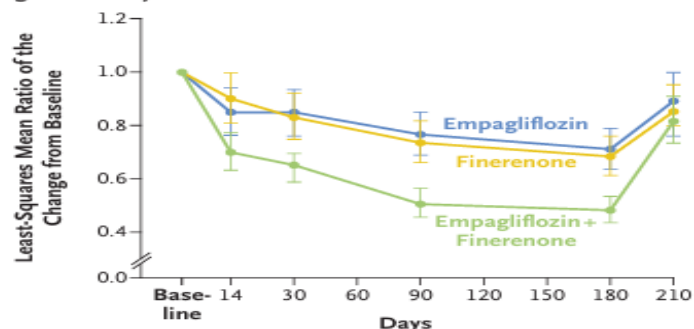
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- Advises a threshold for pharmacologic management of ***130/80mmHg*** or above
- Recommends ***RASi and diuretics*** (e,g Chlotholidone) as first choice
- Emphasizes use of ***SGLT2i, GLP1RA and MRA*** (finerenone) for CKD, DM and metabolic components of CKM

# Anti-hypertensive effects of combined Empagliflozin and Finerenone in T2DM

(Agrawal R, et al [CONFIDENCE Trial] NEJM 2025;393;:533-541)

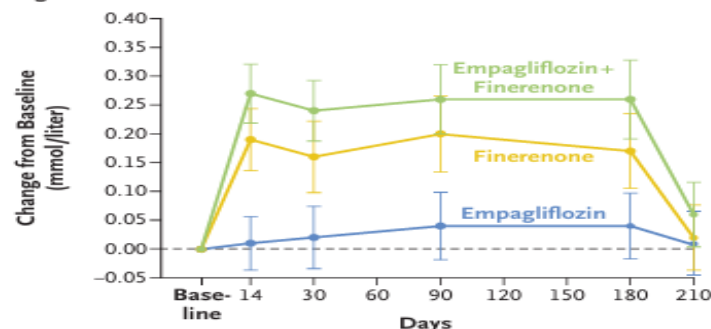
**A** Change in Urinary Albumin-to-Creatinine Ratio



**No. of Patients**

|                            |     |     |     |     |     |     |
|----------------------------|-----|-----|-----|-----|-----|-----|
| Finerenone                 | 258 | 247 | 248 | 237 | 236 | 227 |
| Empagliflozin              | 261 | 254 | 252 | 246 | 238 | 232 |
| Empagliflozin + finerenone | 265 | 248 | 253 | 248 | 240 | 238 |

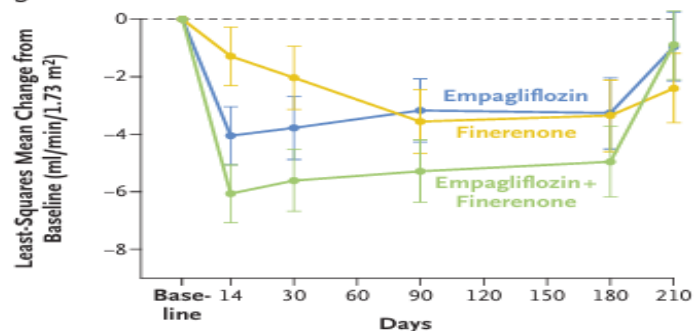
**B** Change in Serum Potassium Level



**No. of Patients**

|                            |     |     |     |     |     |     |
|----------------------------|-----|-----|-----|-----|-----|-----|
| Finerenone                 | 264 | 250 | 252 | 242 | 240 | 235 |
| Empagliflozin              | 266 | 260 | 254 | 250 | 244 | 245 |
| Empagliflozin + finerenone | 267 | 253 | 261 | 254 | 244 | 253 |

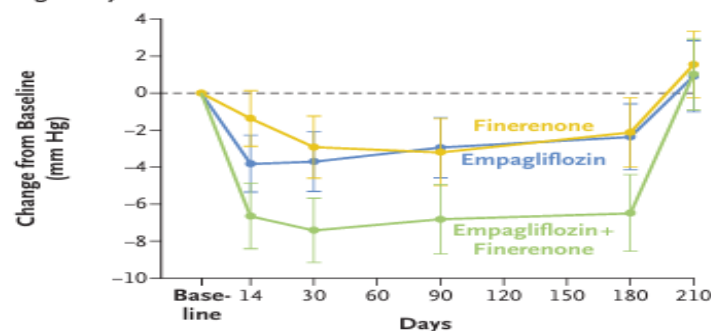
**C** Change in eGFR



**No. of Patients**

|                            |     |     |     |     |     |     |
|----------------------------|-----|-----|-----|-----|-----|-----|
| Finerenone                 | 262 | 250 | 251 | 243 | 239 | 234 |
| Empagliflozin              | 265 | 258 | 255 | 249 | 242 | 243 |
| Empagliflozin + finerenone | 269 | 253 | 261 | 254 | 243 | 253 |

**D** Change in Systolic Blood Pressure



**No. of Patients**

|                            |     |     |     |     |     |     |
|----------------------------|-----|-----|-----|-----|-----|-----|
| Finerenone                 | 264 | 257 | 256 | 248 | 244 | 243 |
| Empagliflozin              | 266 | 261 | 259 | 253 | 247 | 248 |
| Empagliflozin + finerenone | 268 | 255 | 262 | 256 | 247 | 253 |

# Hypertension in CKD-

## *Novel Approaches Under Development on newly applied*

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- **Renal denervation**
- **Endothelin receptor antagonism (Atrasentan, Sparsentan)**
- **Aldosterone synthase inhibitors (Baxdrostat)**
- **Second Generation non-steroidal Mineralocorticoid Receptor antagonists (Ocedurenone)**
- **Others (Modified ANP)**

## SOBERING FACTS:

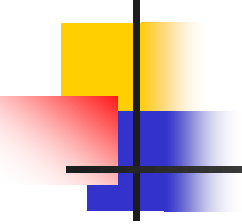
*Too many Americans with Hypertension are not at Guideline Stated Goals*

(Hardy ST, et al and NHANES 2021-2023-JAMA 2026; 335:816-818)

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- **79%** of adults with Hypertension have BP above AHA/ACC 2025 stated goal of <130/80mmHg
- **61%** of these are taking no medication for BP control; **39%** were taking medication but still not at Goal BP
- For those with CKD not at Goal BP, **12%** were not taking any antihypertensive medication and **33%** were taking medication but not at Goal BP





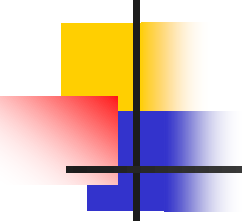
# TAKE HOME MESSAGES and CONCLUSIONS - *I*

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- ***Elevated BP*** (hypertension) is ***common*** in CKD but is more a consequence than causal association. Incident CKD in hypertensive subjects is often due to undiagnosed CKD (such as APOL1 nephropathy, Nephron under-endowment, Primary kidney disease, etc)
- ***Elevated BP*** likely ***contributes*** to CKD progression, in both T2DM and in non-diabetic CKD, at least in later stages and especially in the presence of increased albuminuria/proteinuria
- We doing a ***poor job*** of controlling BP to well-accepted Goals, in both CKD and other diseases

# TAKE HOME MESSAGES and CONCLUSIONS -

## *II*

- 
- ***Intensive BP control*** does not likely prevent non-diabetic CKD, and is only effective in slowing CKD progression in more advanced CKD. Diabetic CKD may be different
  - ***Intensive BP control*** seems to be ***less effective*** in preventing CVD events in CKD due to T2DM and non-diabetic CKD
  - Target BP in CKD varies among published CPG, but values of ***<130/80mmHg*** seem reasonable, especially in CKM Syndrome Stage 3 or greater . Lower values might be appropriate in ADPKD patients
  - ***RAS inhibition, Sodium restriction, diuretics*** (loop and/ or chlorthalidone), ***DHP-CCB*** are usual modalities. Newer therapies are emerging- Renal Denervation, Aldosterone Synthase Inhibitors, SGLT2i + nsMRA in T2DM