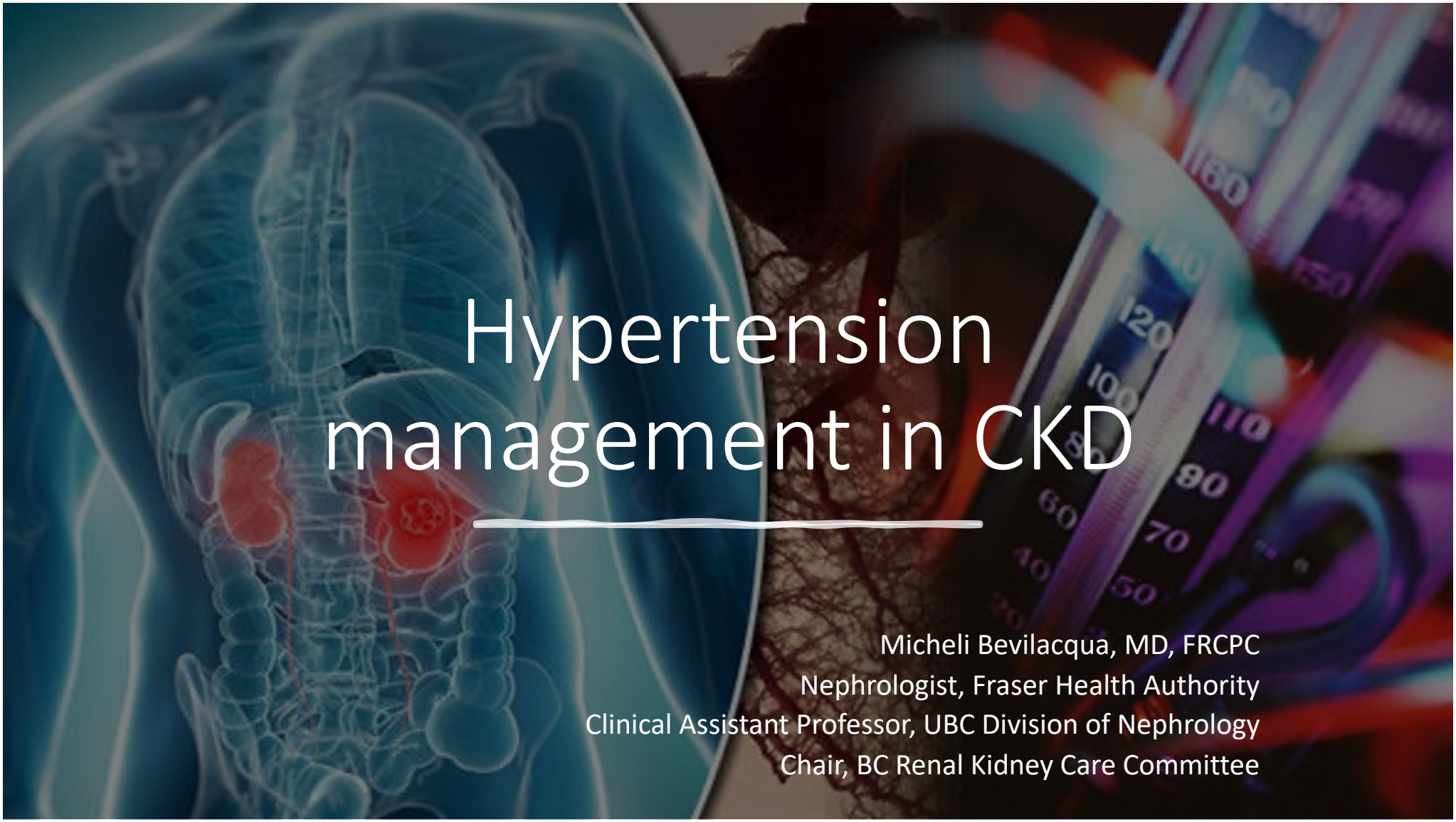

Hypertension management in CKD

Micheli Bevilacqua, MD, FRCPC
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Chair, BC Renal Kidney Care Committee

Disclosures

- I have accepted:
  - Otsuka Pharmaceuticals Canada (advisory, consultant and speaker's fees; grants)
  - Sanofi Canada (advisory fees)
  - Boehringer Ingelheim Canada (speaker's fees, clinical trial involvement)
  - AstraZeneca Canada (speaker's fees)
  - Janssen Canada (advisory and speaker's fees)
  - Novartis (advisory and speaker's fees, clinical trial involvement)

- None of these are relevant to BP management or any other content of this talk
- To mitigate these conflicts: specific drug/trade names will not be discussed in this lecture except for those used in trials

Outline and Objectives

Outline

- Epidemiology of HTN and CKD
- Evidence behind target BPs recommended in guidelines
  - Which targets apply to which patients?
  - Who benefits from a lower target?
- Evidence behind choice of BP agent
  - Who needs RAASi?
- Other management considerations
  - Lifestyle interventions
  - Measuring BP
  - Sick day medication adjustments

Objectives

- Understand the interaction between HTN and CKD
- Understand where BP targets come from and how that applies to individual patients
- Understand the evidence behind choice of BP agents
- Understand proper methods for BP measurement in and out of office

Hypertension and CKD: by the numbers

- Approximately **25%-30%** of Canadians have hypertension (depending on definitions, series)
- Approximately 10% of Canadians have some degree of CKD
  - >19,000 CKD patients in BC registered with BCR (a vast underestimate of provincial rates)

>50% (up to ~80% in some reports) of CKD patients have HTN

- As of 2019, there are 7077 patients with ESKD (dialysis or transplant) in BC
  - In 829 (11%) vascular/HTN nephrosclerosis is listed as the sole cause
  - Attribution is difficult in this setting (more later)

Even for those in whom it is not the cause, BP management is a key management consideration in CKD care

Canadian Institute for Health Information. Annual Statistics on Organ Replacement in Canada: Dialysis, Transplantation and Donation, 2010 to 2019. Ottawa, ON: CIHI; 2020

Blood pressure control is directly related to renal outcomes...

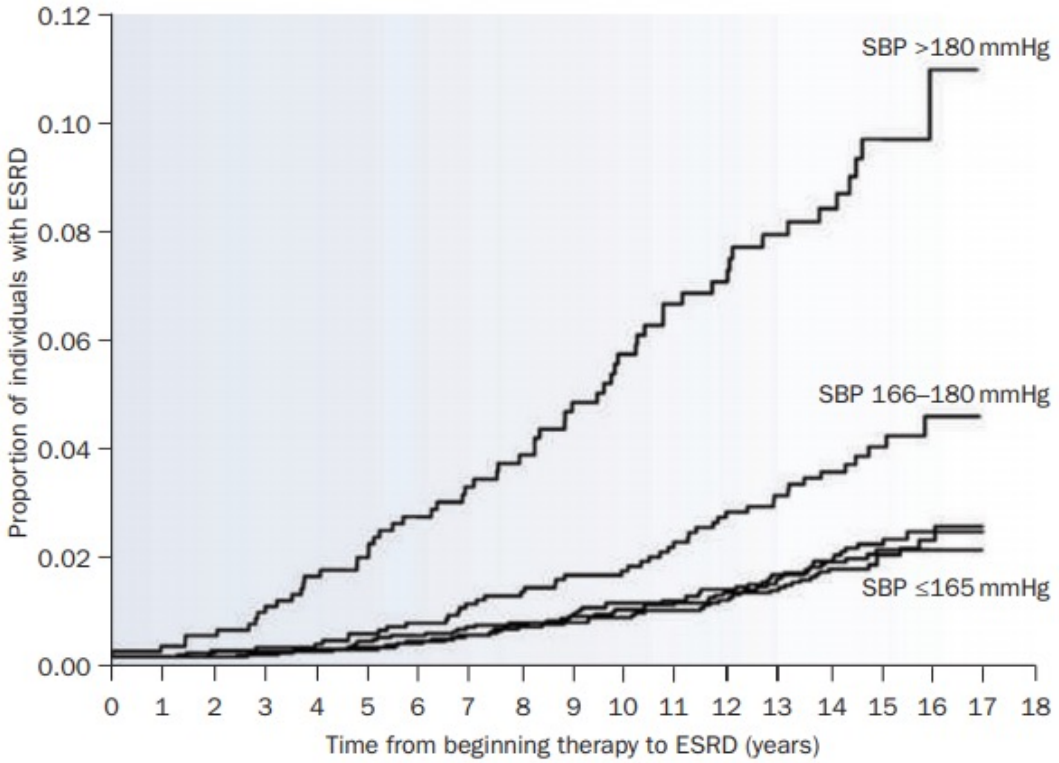
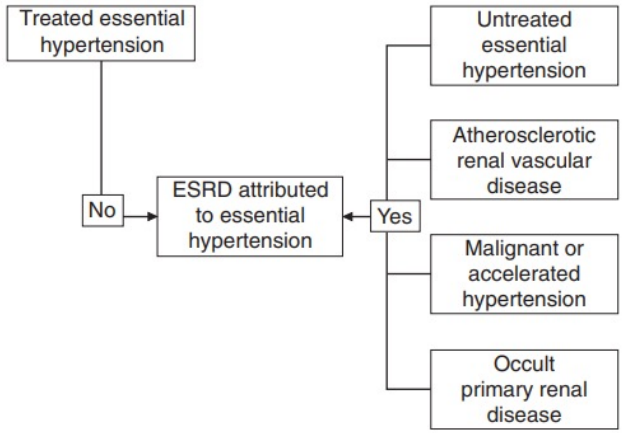


Figure is just renal outcomes, not to mention cardiovascular outcomes

Udani, S. *et al. Nat. Rev. Nephrol.* **7**, 11–21 (2011); published online 16 November 2010; doi:10.1038/nrneph.2010.154

...But, it is not always a straightforward diagnosis/relationship!

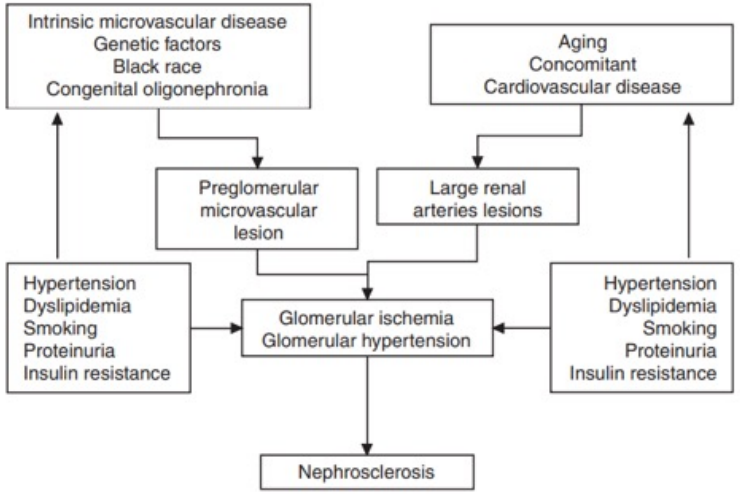


Kidney International, Vol. 68, Supplement 99 (2005), pp. S52–S56

Not all patients with hypertensive nephrosclerosis (even biopsy proven) have systemic/arterial hypertension

AND

Not all hypertensive patients with CKD have hypertensive nephrosclerosis!



Features suggestive of hypertensive nephrosclerosis
Avoid premature diagnostic closure

- Long-standing or severe hypertension (e.g. >10 years)
- Hypertensive retinal changes
- Left ventricular hypertrophy
- Proteinuria less than 0.5 g/d
- Hypertension diagnosed prior to the onset of proteinuria
- Hypertension preceding kidney dysfunction
- Black race
- No signs of alternate diagnosis

Important to do a screen to rule out other causes, especially if it does not fit this patient profile

AND

Don't forget to do a screen for secondary causes of hypertension where appropriate (eg young age, systemic symptoms)

Managing HTN: Targets, targets, targets!

Hypertension CANADA

Patient population	BP treatment target	
	SBP mmHg	DBP mmHg
Hypertension Canada High-Risk Patient*	< 120	N/A
Diabetes mellitus**	< 130	< 80
Moderate-to-high Risk (TOD or CV risk factors)**	< 140	< 90
Low Risk (No TOD or CV risk factors)**	< 140	< 90

CKD is included in the 'high risk' category for Hypertension Canada BUT only non-diabetic and protein <1g/day

KIDNEY DISEASE · IMPROVING GLOBAL OUTCOMES ®

KDIGO Clinical Practice Guideline for the Management of Blood Pressure in Chronic Kidney Disease

VOLUME 2 | ISSUE 5 | DECEMBER 2012

Chapter 3: Blood pressure management in CKD ND patients without diabetes mellitus

3.1: We recommend that non-diabetic adults with CKD ND and urine albumin excretion <30 mg per 24 hours (or equivalent*) whose office BP is consistently >140 mm Hg systolic or >90 mm Hg diastolic be treated with BP-lowering drugs to maintain a BP that is consistently ≤140 mm Hg systolic and ≤90 mm Hg diastolic. *(1B)*

3.2: We suggest that non-diabetic adults with CKD ND and urine albumin excretion of 30 to 300 mg per 24 hours (or equivalent*) whose office BP is consistently >130 mm Hg systolic or >80 mm Hg diastolic be treated with BP-lowering drugs to maintain a BP that is consistently ≤130 mm Hg systolic and ≤80 mm Hg diastolic. *(2D)*

3.3: We suggest that non-diabetic adults with CKD ND and urine albumin excretion >300 mg per 24 hours (or equivalent*) whose office BP is consistently >130 mm Hg systolic or >80 mm Hg diastolic be treated with BP-lowering drugs to maintain a BP that is consistently ≤130 mm Hg systolic and ≤80 mm Hg diastolic. *(2C)*

Chapter 4: Blood pressure management in CKD ND patients with diabetes mellitus

4.1: We recommend that adults with diabetes and CKD ND with urine albumin excretion <30 mg per 24 hours (or equivalent*) whose office BP is consistently >140 mm Hg systolic or >90 mm Hg diastolic be treated with BP-lowering drugs to maintain a BP that is consistently ≤140 mm Hg systolic and ≤90 mm Hg diastolic. *(1B)*

4.2: We suggest that adults with diabetes and CKD ND with urine albumin excretion >30 mg per 24 hours (or equivalent*) whose office BP is consistently >130 mm Hg systolic or >80 mm Hg diastolic be treated with BP-lowering drugs to maintain a BP that is consistently ≤130 mm Hg systolic and ≤80 mm Hg diastolic. *(2D)*

KIDNEY DISEASE · IMPROVING GLOBAL OUTCOMES

KDIGO 2021 Clinical Practice Guideline for the Management of Blood Pressure in Chronic Kidney Disease

Recommendation 3.1.1: We suggest that adults with high BP and CKD be treated with a target systolic blood pressure (SBP) of <120 mm Hg, when tolerated, using standardized office BP measurement (*2B*).

Whirlwind tour of HTN evidence

Where did these targets come from?

HOT trial: 'Goldilocks'

- 18790 patients randomized to different BP targets (as well as to ASA or not)
- This is where the 'sweet spot' for BP control comes from (138/86)
  - In general no benefit of going lower AND increased CV mortality

Combined endpoint

MI

Stroke

CV mortality

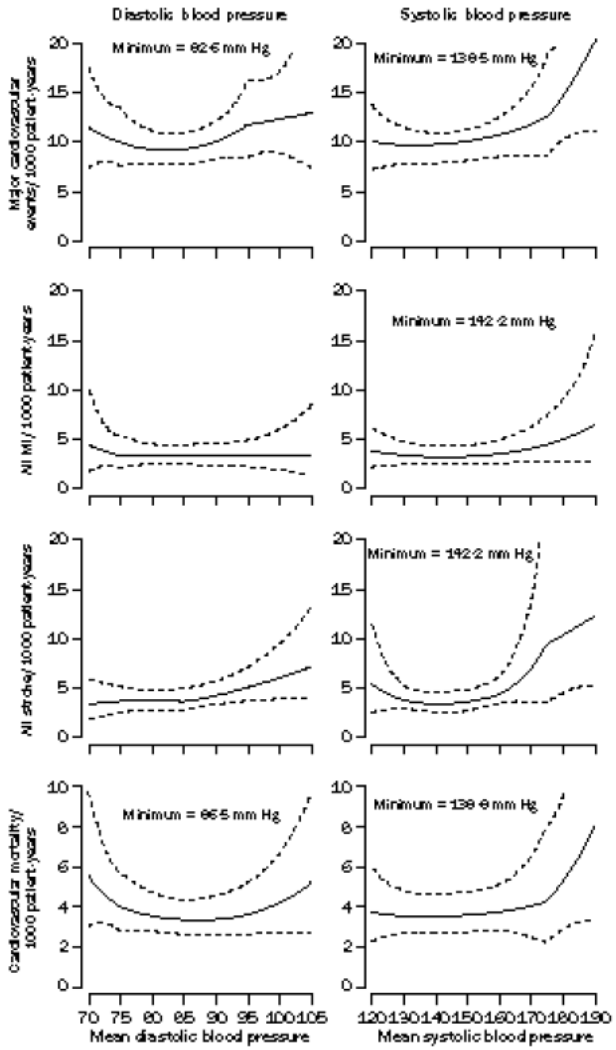
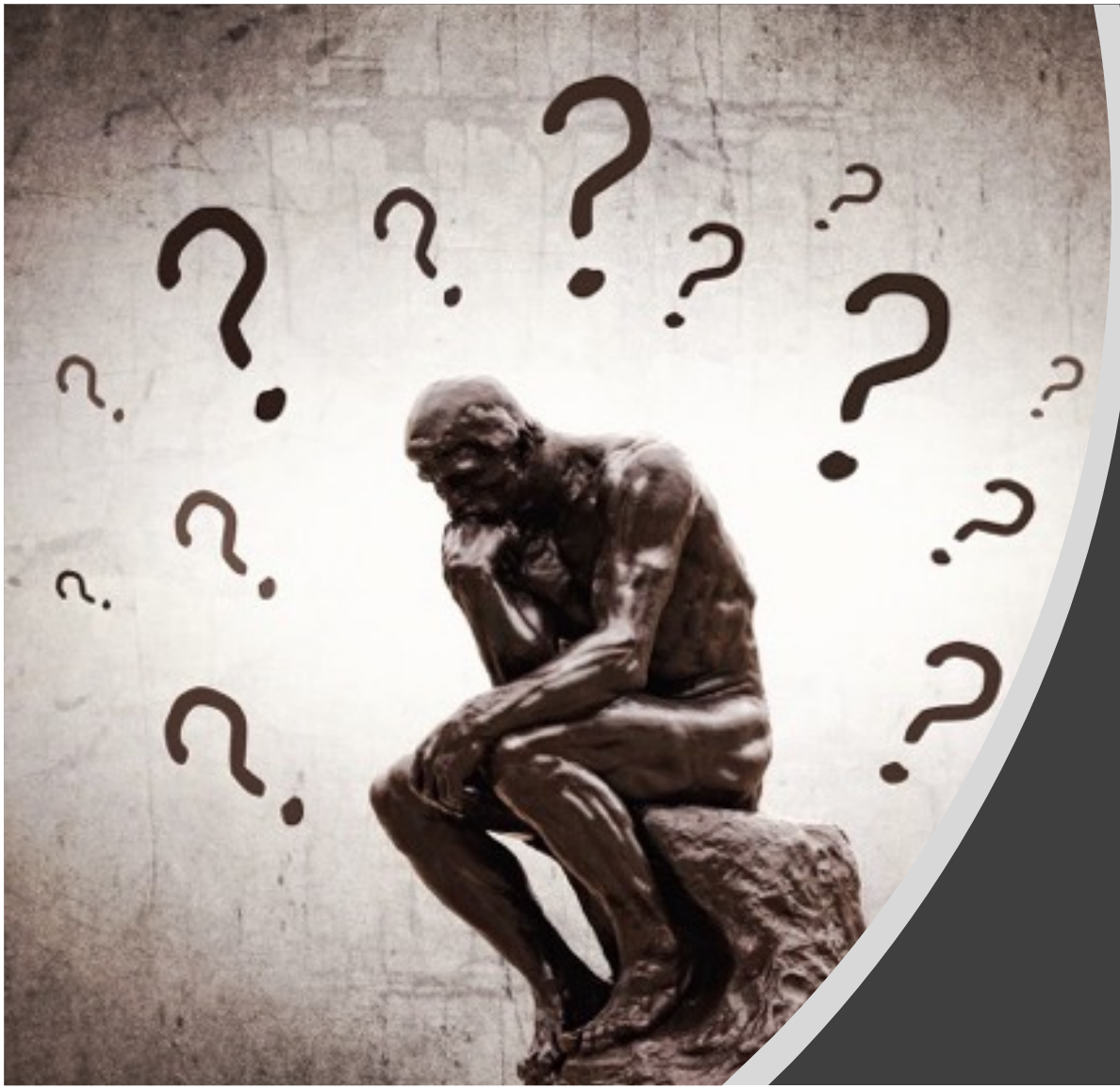


Figure 3: **Estimated incidence (95% CI) of cardiovascular events in relation to achieved mean diastolic and systolic blood pressure**
The blood pressure at the lowest point of the curve is indicated (minimum).

Lancet 1998; **351:** 1755–62



Big Question 1: Is lower better in CKD patients?

Landmark trials in CKD and HTN

Recall targets from KDIGO 2012 (Using this one as it reflects the evidence base)

Non-DM CKD

ACR <3, Target <140/90 (1B)

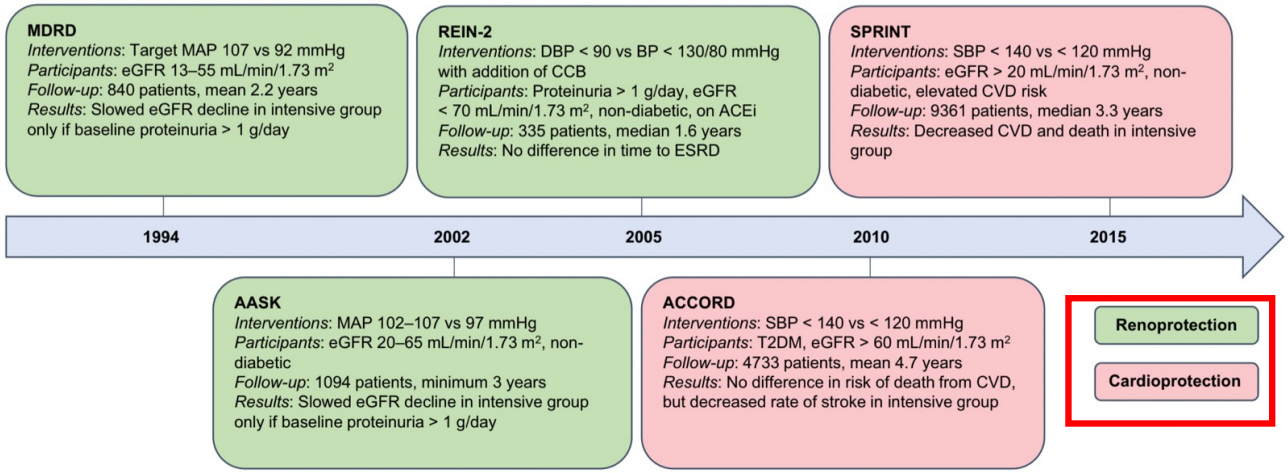
ACR 3-30, Target <130/80 (2D)

ACR >30, Target <130/80 (2C)

Diabetic CKD

ACR <3, Target <140/90 (1B)

ACR >3, Target < 130/80 (2D)



Drugs (2019) 79:365–379
https://doi.org/10.1007/s40265-019-1064-1

REIN 2: Non-diabetic CKD

- Non-diabetic CKD treated with ramipril
- Randomized to either conventional (DBP <90) or intensified (<130/80) BP control
- No difference in outcomes

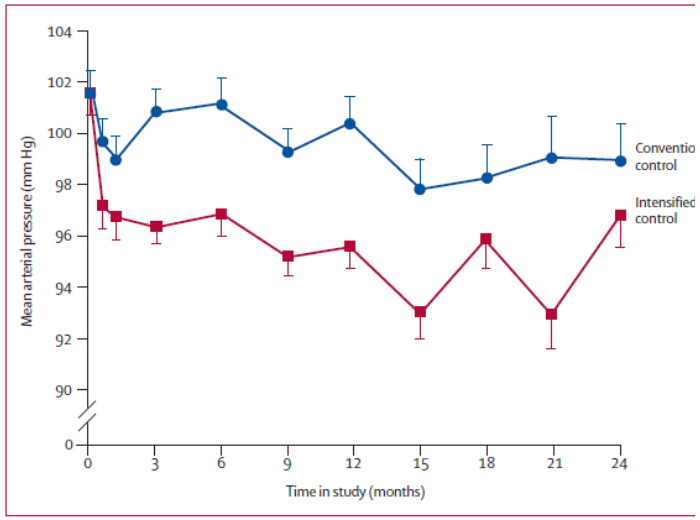


Figure 2: Mean arterial pressure in each study arm
Error bars are SE.

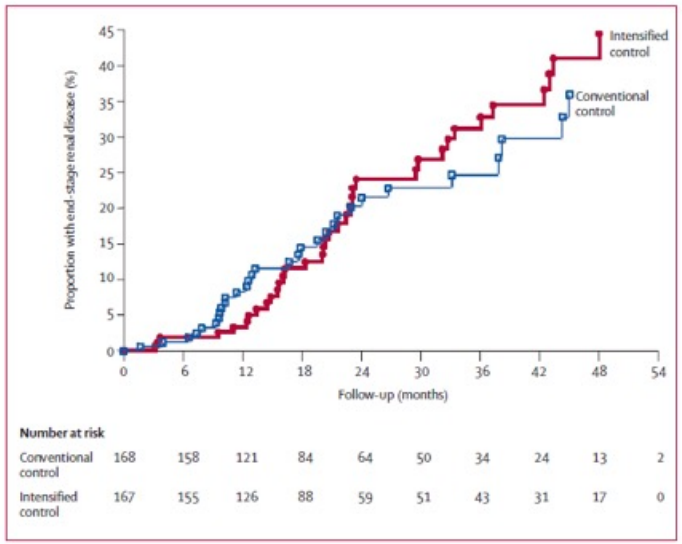


Figure 3: Proportion of patients with end-stage renal disease in each study arm

Lancet 2005; 365: 939–46

MDRD

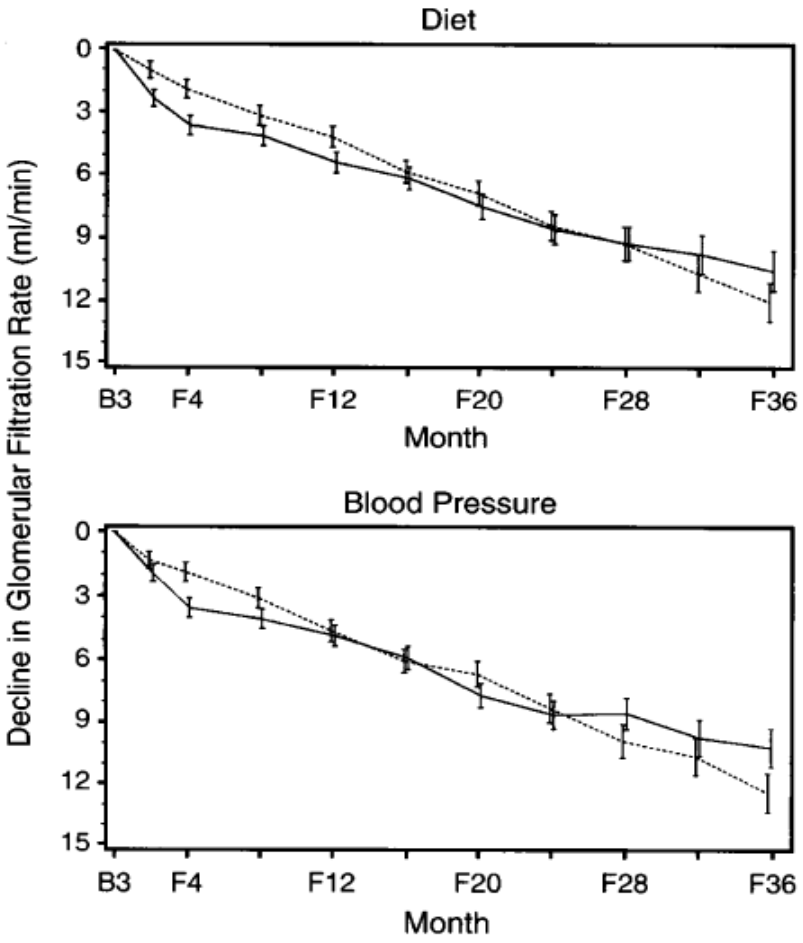
The New England
Journal of Medicine

Volume 330 MARCH 31, 1994 Number 13

THE EFFECTS OF DIETARY PROTEIN RESTRICTION AND BLOOD-PRESSURE CONTROL ON THE PROGRESSION OF CHRONIC RENAL DISEASE

Saulo Klahr, M.D., Andrew S. Levey, M.D., Gerald J. Beck, Ph.D., Arlene W. Caggiula, Ph.D., Lawrence Hunsicker, M.D., John W. Kusek, Ph.D., and Gary Striker, M.D., for the Modification of Diet in Renal Disease Study Group*

- In this study, patients with non-diabetic CKD (Cr 106-619) were randomized to a normal or low protein diet as well as normal or low blood pressure goals (MAP 107 vs 92).
- The majority of patients in this study had either glomerular disease or PCKD as their cause of CKD



- Dashed = usual BP (MAP = 96; ~130/80)
- Solid = low BP (MAP = 91; ~127/75)

MDRD

- For the whole population, there was no difference with the lower goal

BUT

- There was a difference in the proteinuric patients

- Not shown but a longer term follow up was done, showed sustained effect

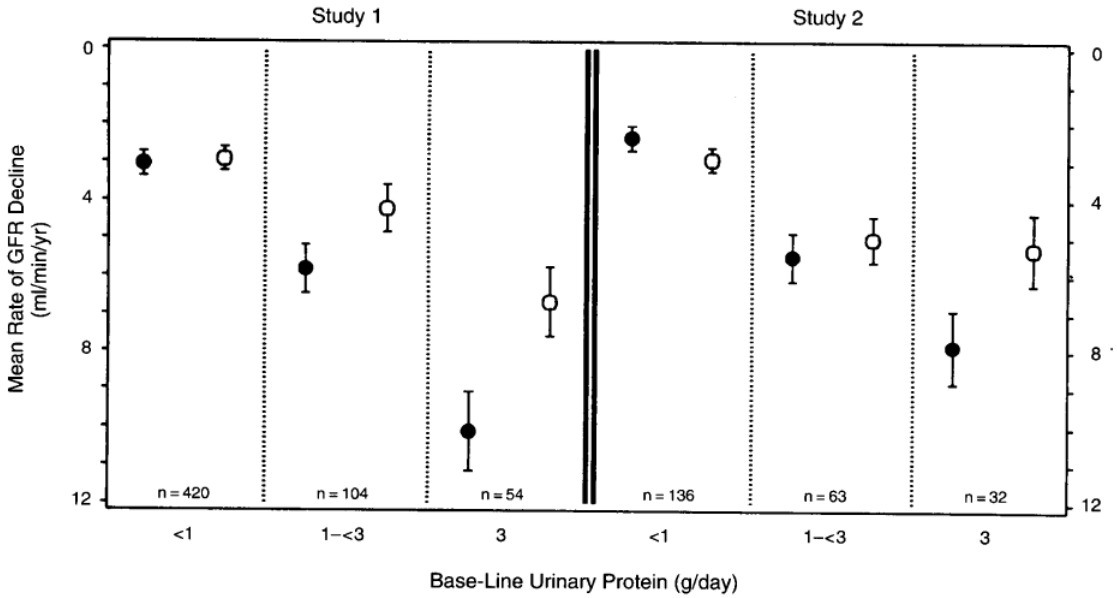
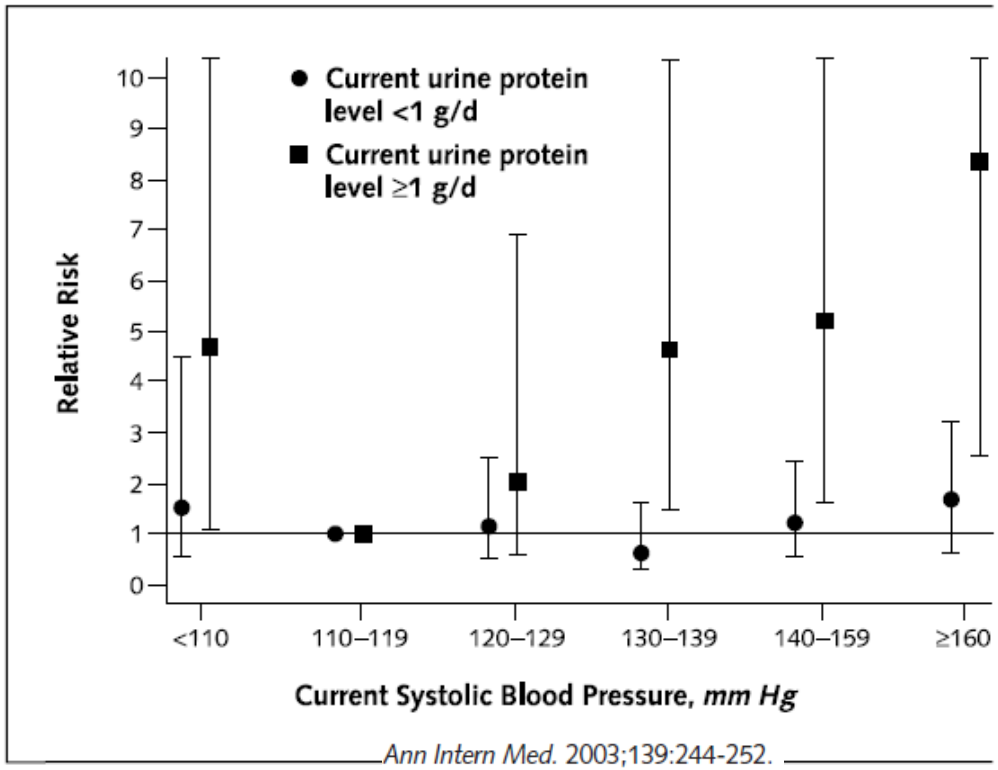


Figure 3. Decline in the Glomerular Filtration Rate (GFR) According to Base-Line Urinary Protein Excretion and Blood-Pressure Group in Studies 1 and 2.

Non-diabetic CKD

- A subsequent meta-analysis of RCTs (including MDRD and another landmark similar trial, AASK) of non-diabetic CKD patients
- Both the level of hypertension and proteinuria were shown to be independently associated with higher rates of CKD progression; any BP above 140 and any proteinuria >2g/day were significantly higher with a trend at lower levels.
- The two variables are synergistic; patients with >1.0g/day of proteinuria had significant, more than two-fold higher rates of CKD progression with BP >130, with the lowest rates of CKD progression seen in the 110-119 group.
- **There was no significant difference in rates of CKD progression seen in patients with less than 1.0g/day of proteinuria.**

Figure. Relative risk for kidney disease progression based on current level of systolic blood pressure and current urine protein excretion.



Ann Intern Med. 2003;139:244-252.

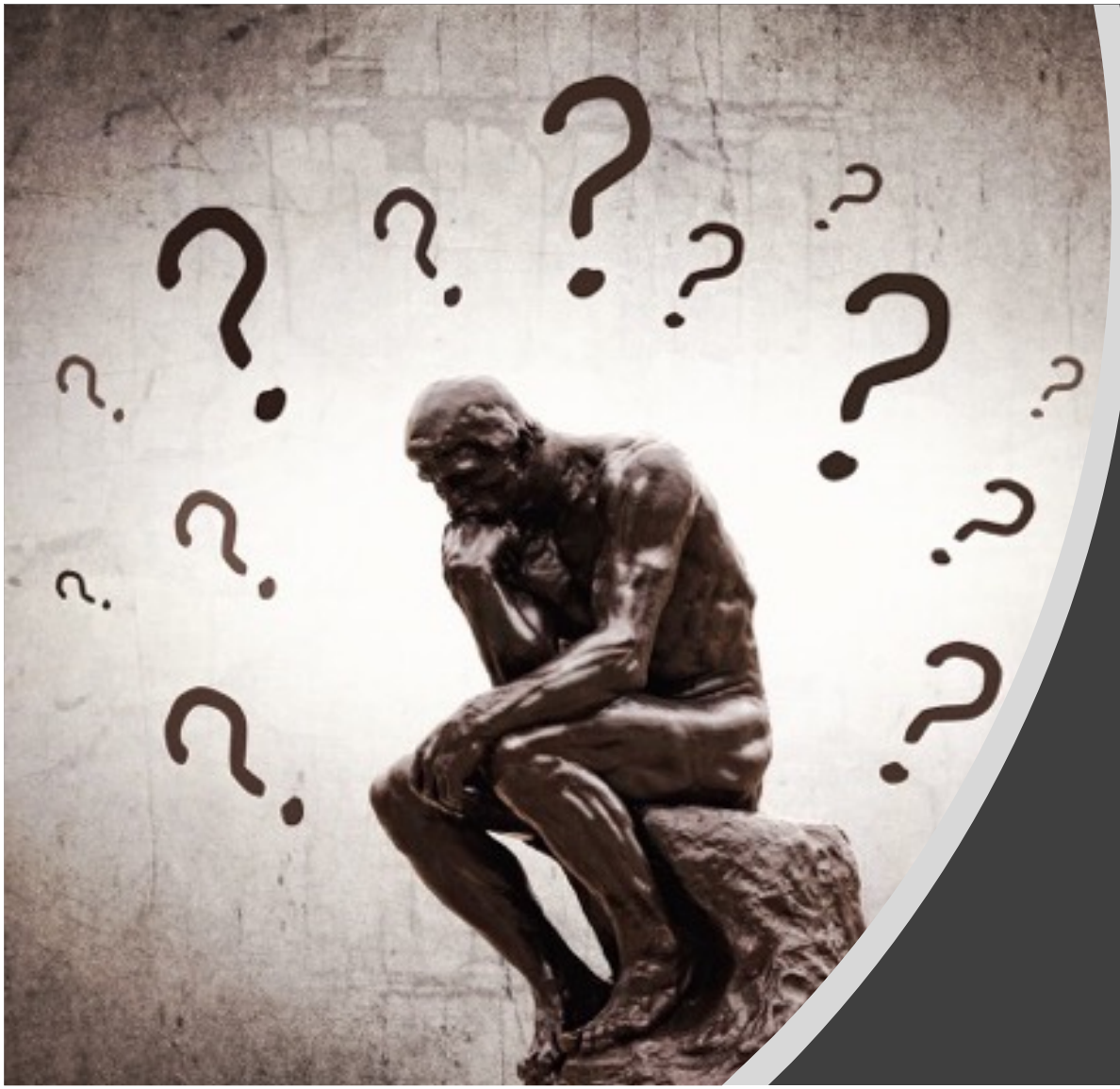
Non-diabetic CKD

Recall targets from KDIGO 2012 (Using this one as it reflects the evidence base)

Non-DM CKD
ACR <3, Target <140/90 (1B)
ACR 3-30, Target <130/80 (2D)
ACR >30, Target <130/80 (2C)

Diabetic CKD
ACR <3, Target <140/90 (1B)
ACR >3, Target < 130/80 (2D)

- If there is protein, the above represent evidence to support the goal of 130/80
- If there is no proteinuria, there was no evidence to treat to a lower target
- Since the above studies showed a significant difference with protein >3g but a less clear difference with 1-3g, that is why the grading of the recommendation is slightly stronger for >3g.



Big Question 2: Are the BP targets any different for diabetic CKD?

- Since the UKPDS studies, it has been clear that higher blood pressure is correlated with worse micro and macrovascular outcomes in diabetics

- This is observational data of diabetic patients

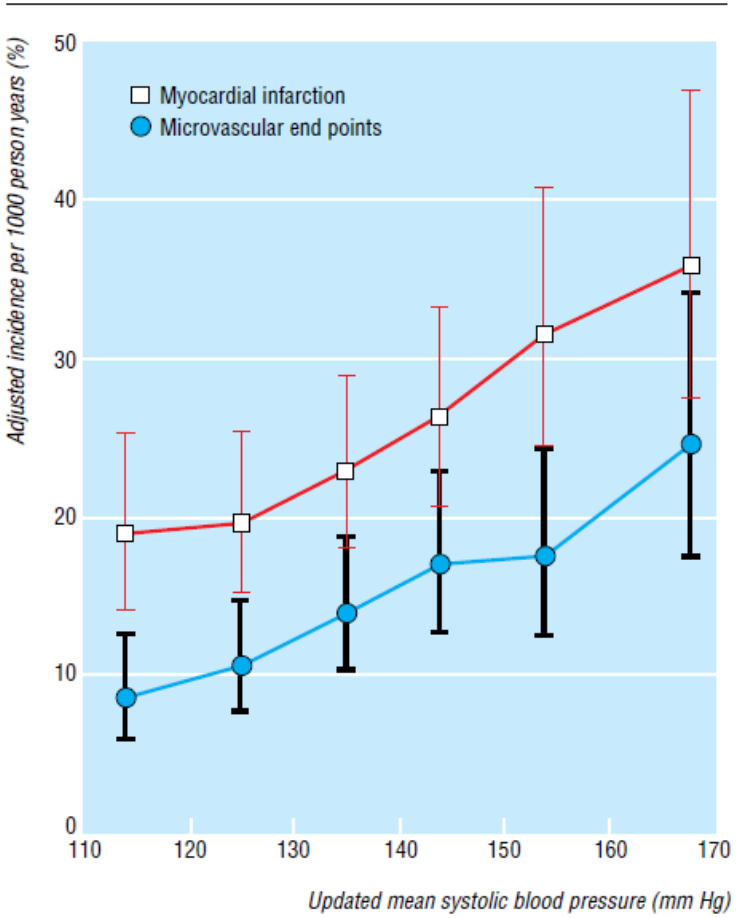


Fig 2 Incidence rates (95% confidence interval) of myocardial infarction and microvascular end points by category of updated mean systolic blood pressure, adjusted for age, sex, and ethnic group expressed for white men aged 50-54 years at diagnosis and mean duration of diabetes of 10 years

BMJ 2000;321:412–9

ADVANCE

- The ADVANCE trial went on to randomize 11140 hypertense diabetics to perindopril + indapamide or placebo
- The patients treated with perindopril-indapamide had a reduction in mean blood pressure to 134.5/74 v 140/76
- This trial demonstrated a clear benefit in treating hypertense diabetics, but we would not now consider this a 'low' BP target

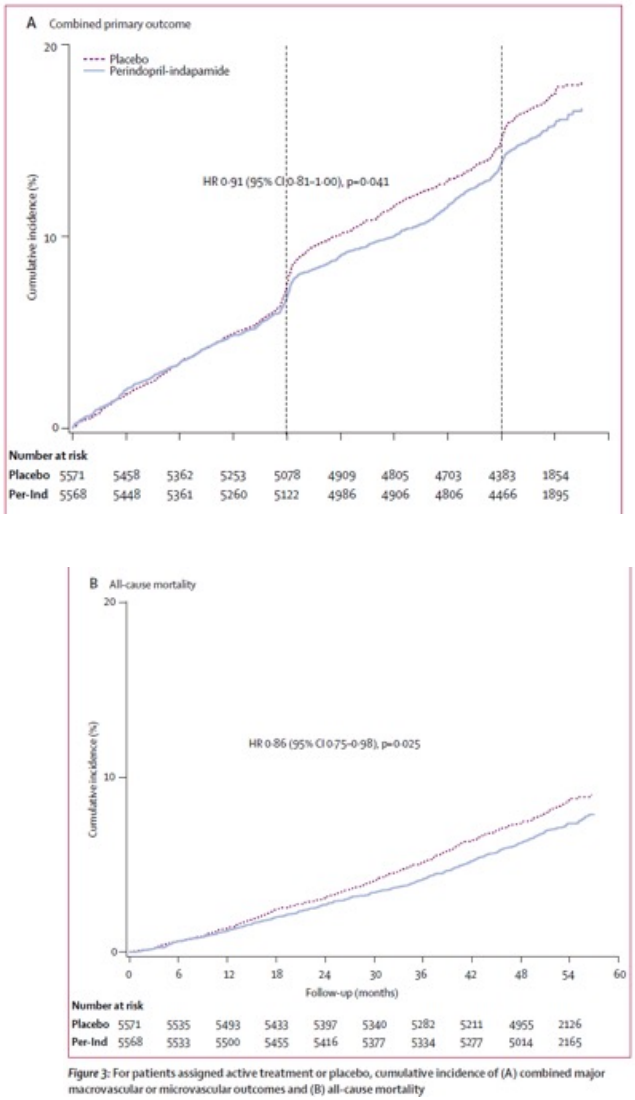
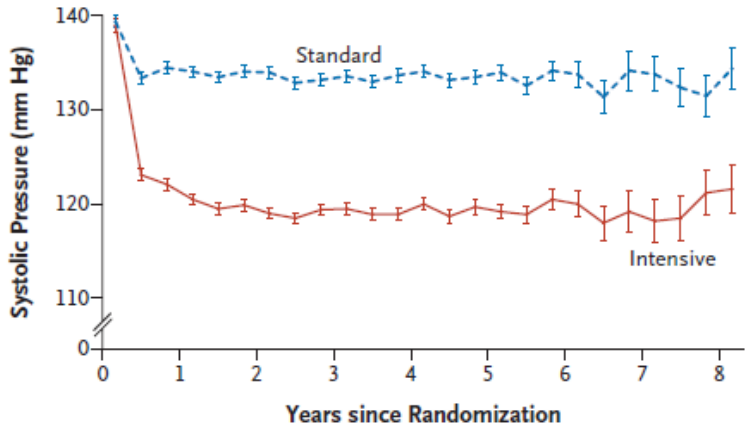


Figure 3: For patients assigned active treatment or placebo, cumulative incidence of (A) combined major macrovascular or microvascular outcomes and (B) all-cause mortality

Lancet 2007; 370: 829–40

ACCORD

- The ACCORD trial randomized 4733 with DM2 to different BP goals – either SBP of 120 or 140mmHg
- The achieved BPs in this trial were 119/64.4 v 133.5/70.5
  - (More meds needed)



Mean No. of Medications Prescribed								
Intensive	3.2	3.4	3.4	3.5	3.5	3.5	3.4	3.4
Standard	1.9	2.1	2.1	2.2	2.2	2.3	2.3	2.3
No. of Patients								
Intensive	2174	2071	1973	1792	1150	445	156	156
Standard	2208	2136	2077	1860	1241	504	203	201

Figure 1. Mean Systolic Blood-Pressure Levels at Each Study Visit.
I bars indicate 95% confidence intervals.

N Engl J Med 2010;362:1575-85.

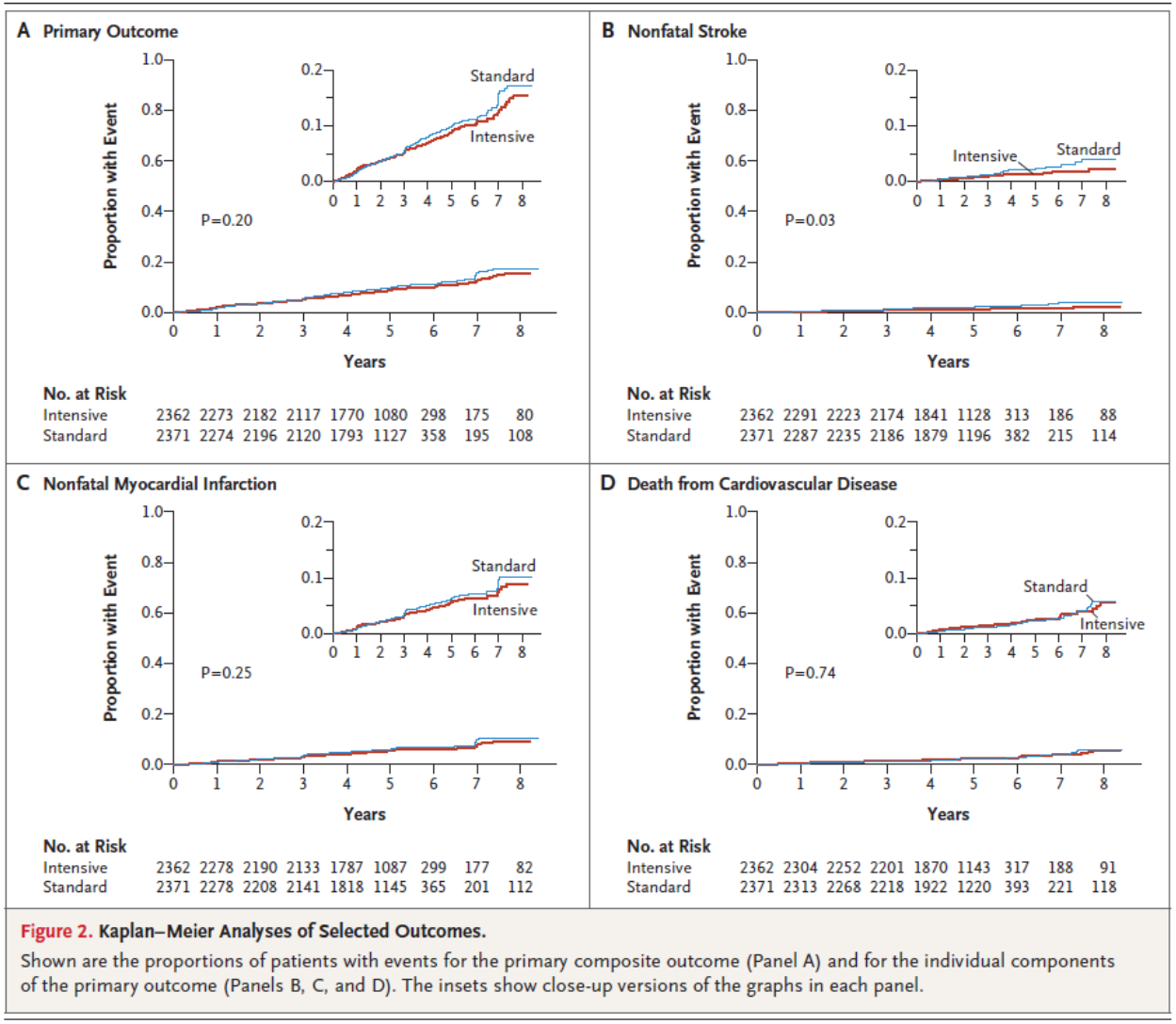


Figure 2. Kaplan–Meier Analyses of Selected Outcomes.
Shown are the proportions of patients with events for the primary composite outcome (Panel A) and for the individual components of the primary outcome (Panels B, C, and D). The insets show close-up versions of the graphs in each panel.

- There was no difference in endpoints between the intensive and standard BP arms
- The intensive group had a significant decrease in the rate of stroke (0.32% per year vs 0.53% per year)
- BUT, the intensive group required more drugs **and had significantly more adverse events** including hypotension, increased creatinine/AKI

Non-proteinuric DM CKD

Recall targets from KDIGO 2012 (Using this one as it reflects the evidence base)

Non-DM CKD
ACR <3, Target <140/90 (1B)
ACR 3-30, Target <130/80 (2D)
ACR >30, Target <130/80 (2C)

Diabetic CKD
ACR <3, Target <140/90 (1B)
ACR >3, Target < 130/80 (2D)

- This is why the strongest recommendation is to treat non-proteinuric diabetic CKD to <140/90 and any recommendation for BP lower than this is a weak one
- Practically, you can consider going lower than this, but know there is a **higher risk** of adverse events including the higher creatinine levels seen in ACCORD
- Even more caution that if BP is lowered to below <120/70, this is more strongly associated with harm

Proteinuric DM CKD

Recall targets from KDIGO 2012 (Using this one as it reflects the evidence base)

Non-DM CKD
ACR <3, Target <140/90 (1B)
ACR 3-30, Target <130/80 (2D)
ACR >30, Target <130/80 (2C)

Diabetic CKD
ACR <3, Target <140/90 (1B)
ACR >3, Target < 130/80 (2D)

- Most evidence regarding BP goals in this setting comes from observational studies
- The above studies either did not quantify proteinuria or were not powered to detect different BP goals based on degree of proteinuria
- So although we extrapolate from the general proteinuric CKD data and feel stronger about a lower BP target in proteinuric diabetic patients, the direct evidence for a lower BP target is scant
  - Hence the 2D for <130/80 vs 1B for <140/90

SPRINT

Changing all the guidelines!

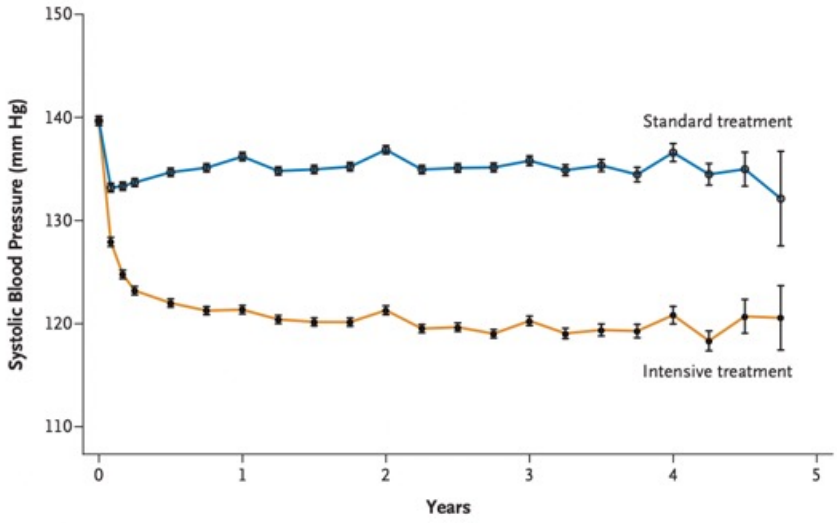
- **Non-diabetic**, high cardiovascular risk
- Randomized to SBP <140 (standard) or SBP <120 (intensive)
- Included some with CKD but excluded protein >1g
- Primary outcome is MACE not renal outcomes

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 NOVEMBER 26, 2015 VOL. 373 NO. 22

A Randomized Trial of Intensive versus Standard Blood-Pressure Control

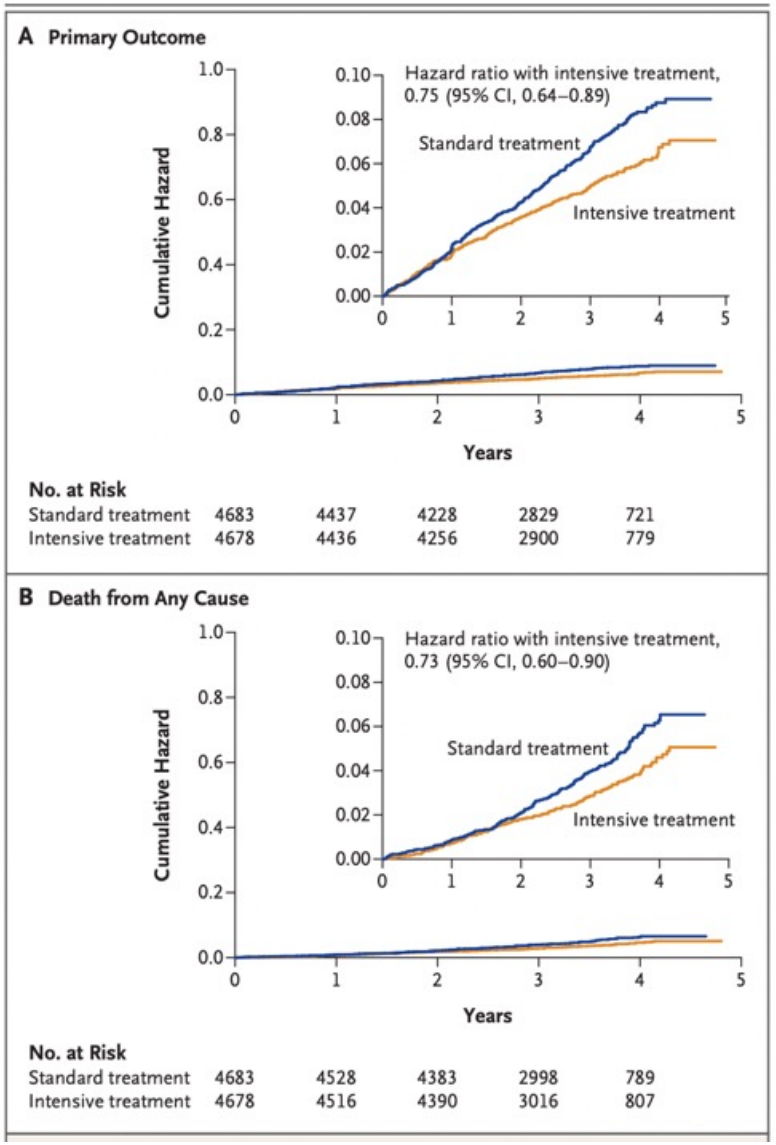
The SPRINT Research Group*



No. with Data										
Standard treatment	4683	4345	4222	4092	3997	3904	3115	1974	1000	274
Intensive treatment	4678	4375	4231	4091	4029	3920	3204	2035	1048	286

Mean No. of Medications										
Standard treatment	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.9
Intensive treatment	2.3	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.8	3.0

- Able to achieve target (with more medications)
- Trial stopped early due to evidence of benefit



- Not powered for subgroups, but trend for CKD
- Note benefit is preserved for other groups including >75 yo

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)	

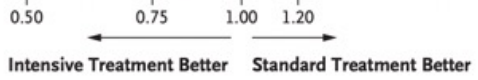


Figure 4. Forest Plot of Primary Outcome According to Subgroups.

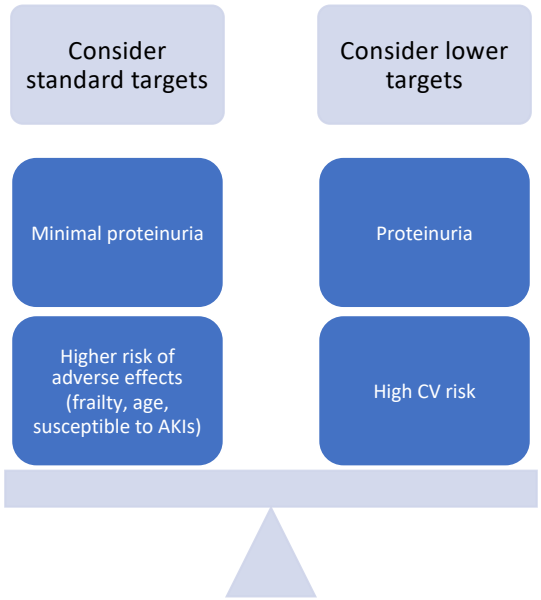
The dashed vertical line represents the hazard ratio for the overall study population. The box sizes are proportional to the precision of the estimates (with larger boxes indicating a greater degree of precision). The subgroup of no previous chronic kidney disease (CKD) includes some participants with unknown CKD status at baseline. Black race includes Hispanic black and black as part of a multiracial identification.

Table 3. Serious Adverse Events, Conditions of Interest, and Monitored Clinical Events.

Variable	Intensive Treatment (N=4678)	Standard Treatment (N=4683)	Hazard Ratio	P Value
	no. of patients (%)			
Serious adverse event*	1793 (38.3)	1736 (37.1)	1.04	0.25
Conditions of interest				
Serious adverse event only				
Hypotension	110 (2.4)	66 (1.4)	1.67	0.001
Syncope	107 (2.3)	80 (1.7)	1.33	0.05
Bradycardia	87 (1.9)	73 (1.6)	1.19	0.28
Electrolyte abnormality	144 (3.1)	107 (2.3)	1.35	0.02
Injurious fall†	105 (2.2)	110 (2.3)	0.95	0.71
Acute kidney injury or acute renal failure‡	193 (4.1)	117 (2.5)	1.66	<0.001
Emergency department visit or serious adverse event				
Hypotension	158 (3.4)	93 (2.0)	1.70	<0.001
Syncope	163 (3.5)	113 (2.4)	1.44	0.003
Bradycardia	104 (2.2)	83 (1.8)	1.25	0.13
Electrolyte abnormality	177 (3.8)	129 (2.8)	1.38	0.006
Injurious fall†	334 (7.1)	332 (7.1)	1.00	0.97
Acute kidney injury or acute renal failure‡	204 (4.4)	120 (2.6)	1.71	<0.001
Monitored clinical events				
Adverse laboratory measure§				
Serum sodium <130 mmol/liter	180 (3.8)	100 (2.1)	1.76	<0.001
Serum sodium >150 mmol/liter	6 (0.1)	0		0.02
Serum potassium <3.0 mmol/liter	114 (2.4)	74 (1.6)	1.50	0.006
Serum potassium >5.5 mmol/liter	176 (3.8)	171 (3.7)	1.00	0.97
Orthostatic hypotension¶				
Alone	777 (16.6)	857 (18.3)	0.88	0.01
With dizziness	62 (1.3)	71 (1.5)	0.85	0.35

The benefit comes at an **increased risk** of adverse events including AKI, hypotension, orthostasis, electrolyte abnormalities

Putting it all together: BP targets

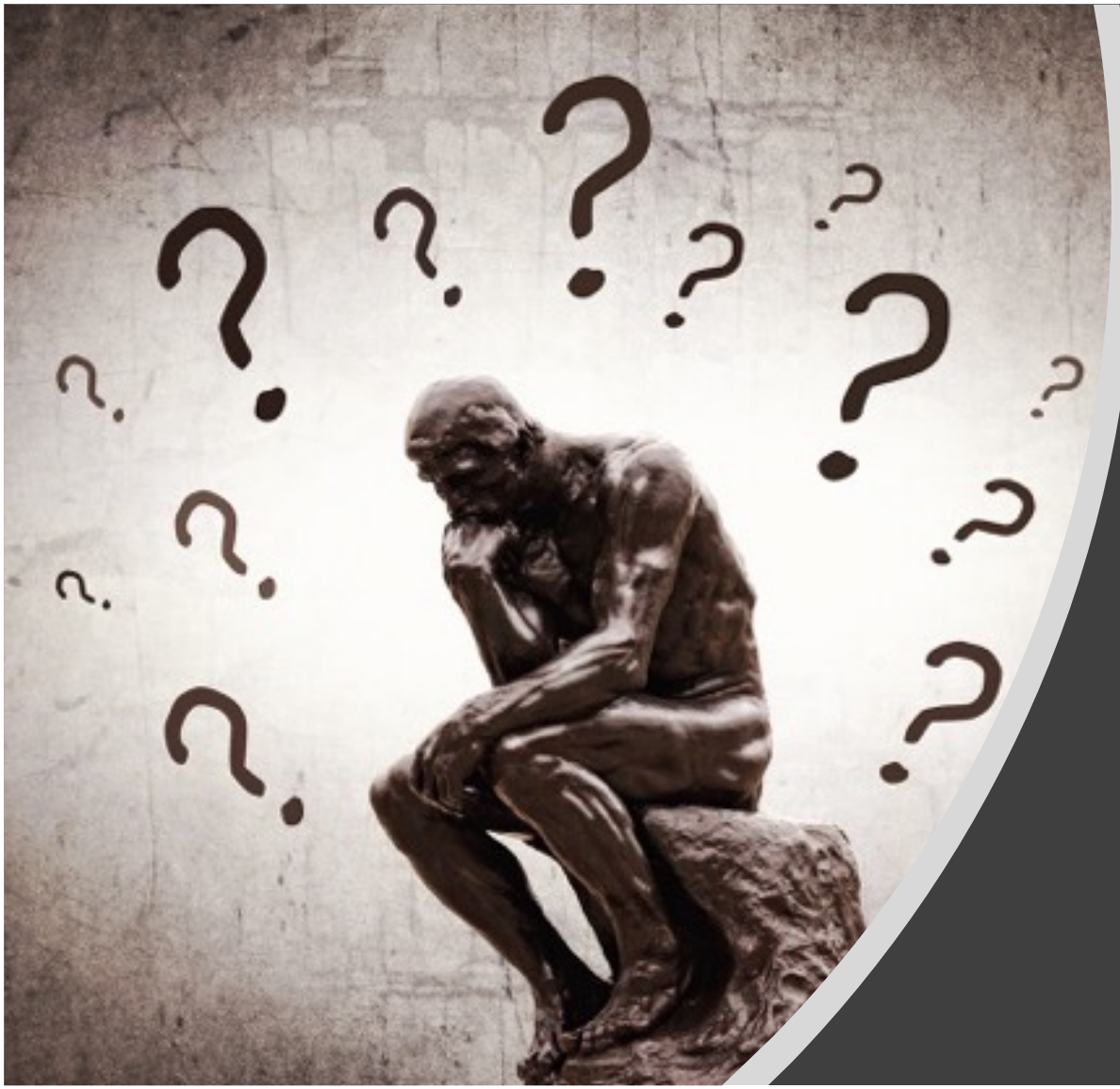


Potential benefits: Better CV outcomes, better renal outcomes

Potential risks: AKI, hypotension, orthostasis, electrolyte abnormalities

Targets should always be individualized

- If using an aggressive target, counsel patients of the risk
- If you run into trouble, consider what the evidence was for a stricter target and consider backing off when you think risk outweighs the benefit

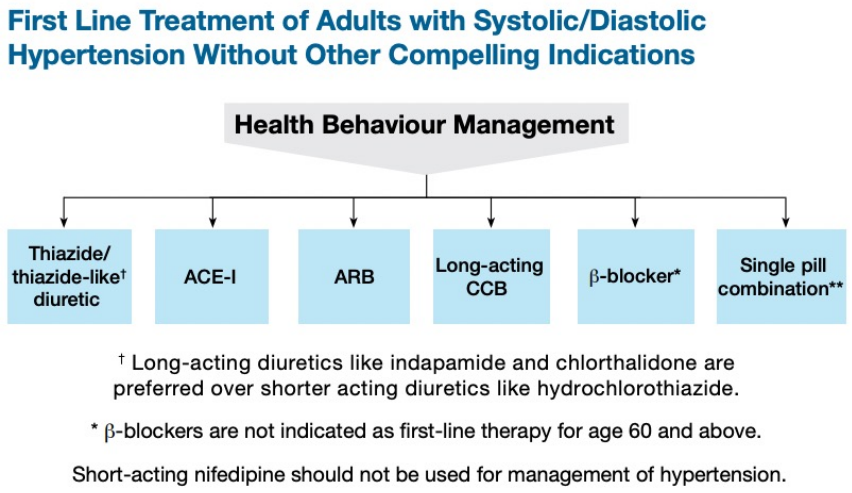


Big Question 3: Does the drug matter?

Who gets RAASi?

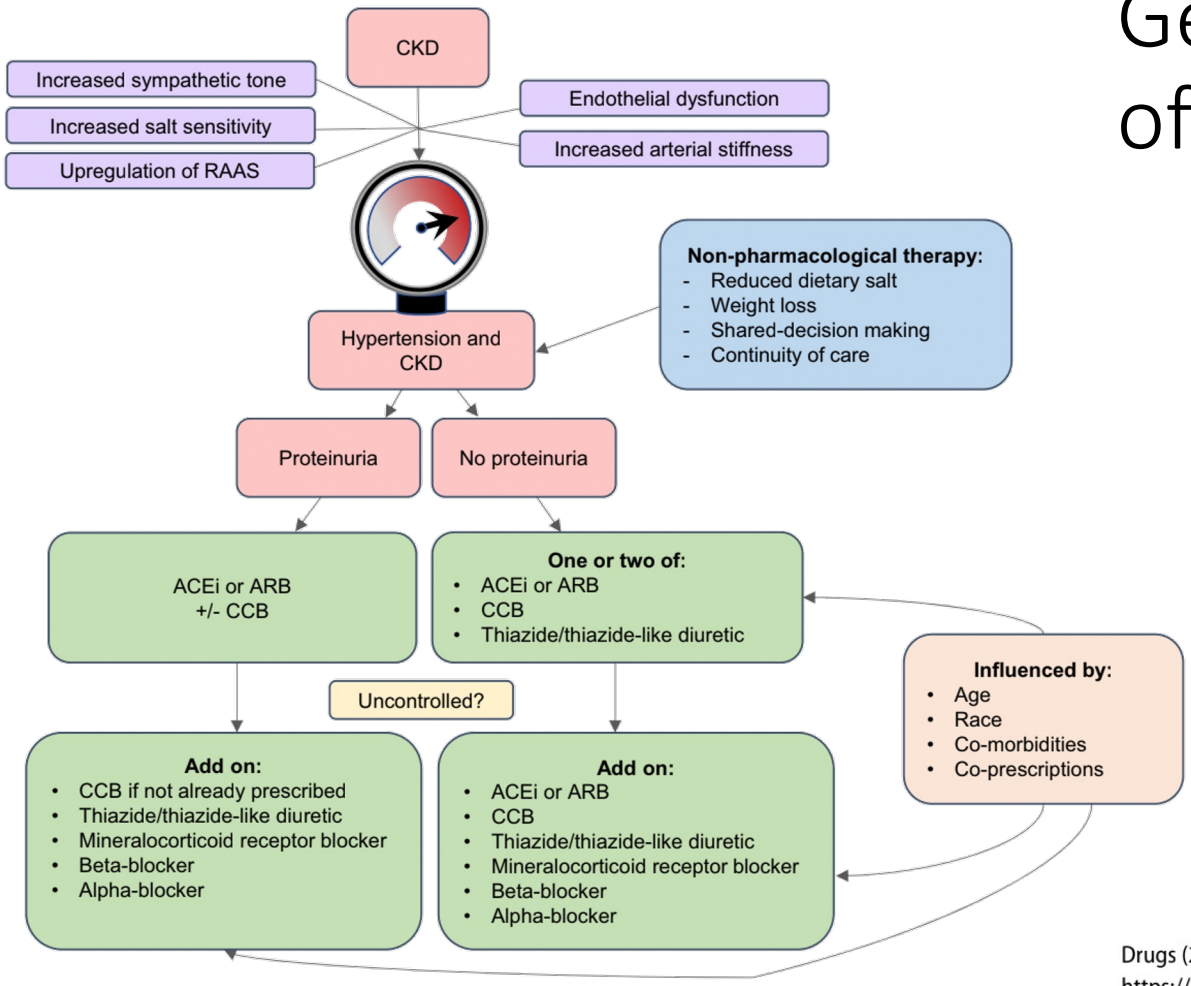
Who gets RAAS blockade?

- There is no specific evidence in the non-diabetic, non-proteinuric population, so for these patients, we essentially treat as the general population, so any drug is acceptable



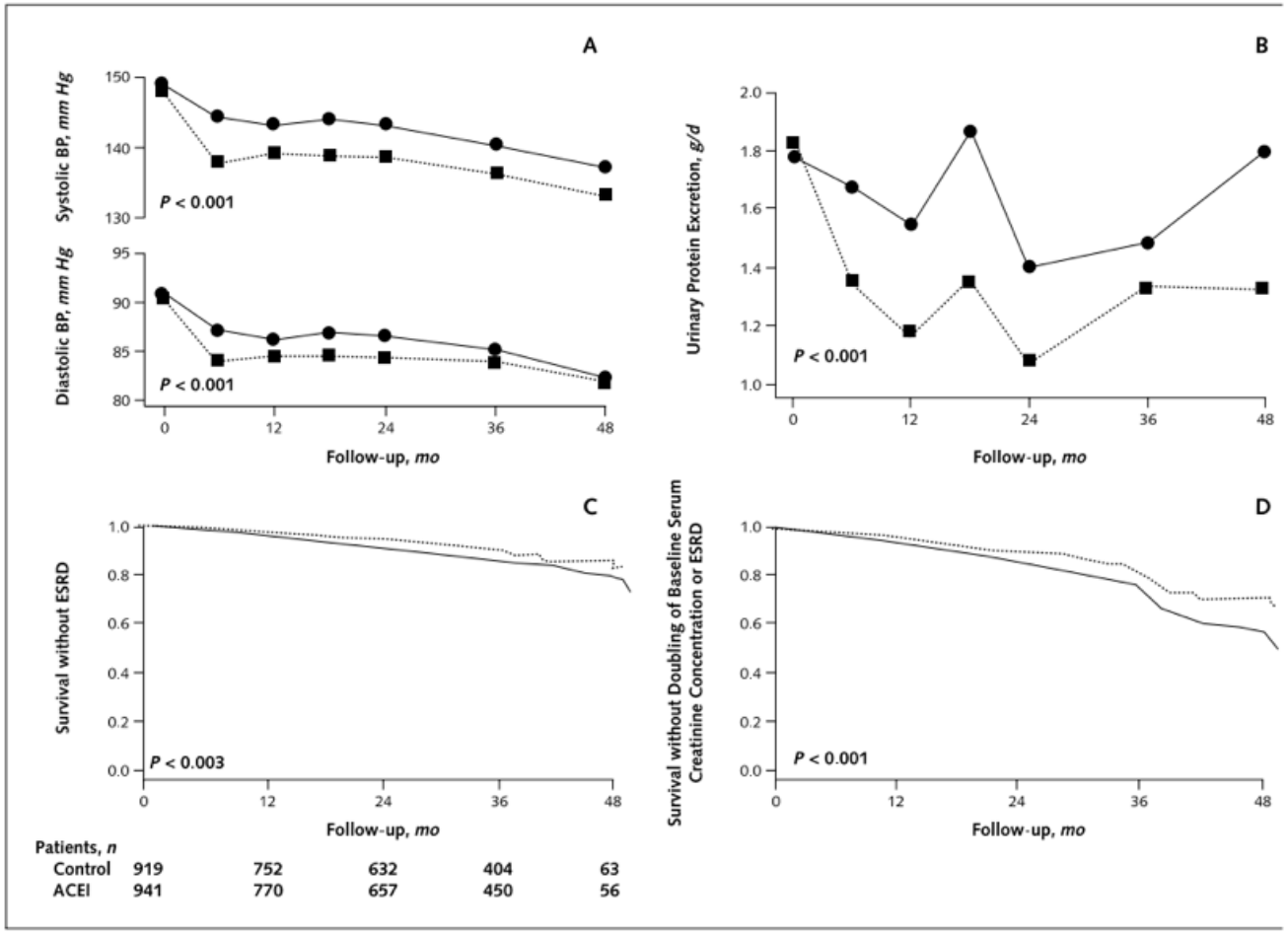
Hypertension CANADA

General flowchart of drug choices



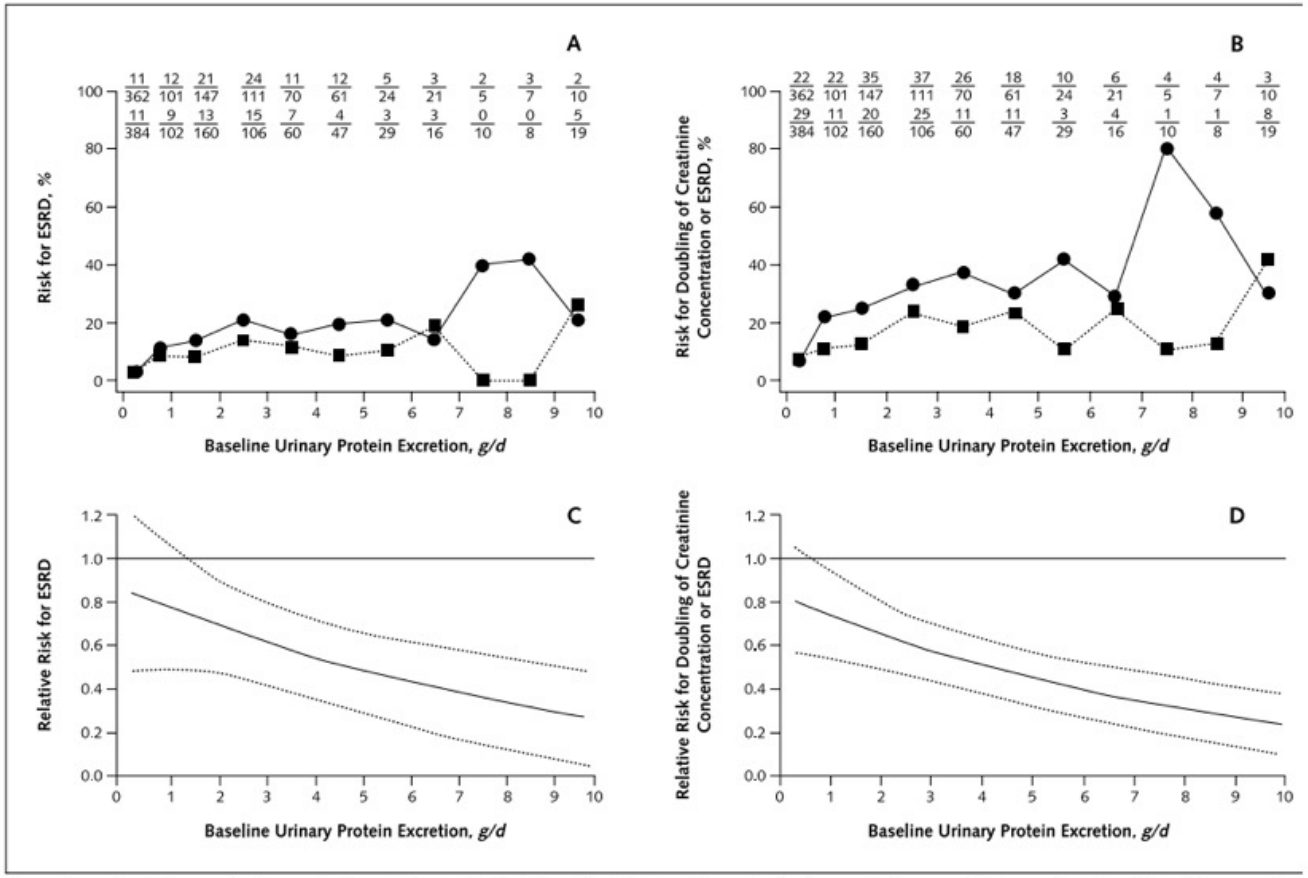
Drugs (2019) 79:365–379
https://doi.org/10.1007/s40265-019-1064-1

Figure 1. Blood pressure (*A*), urinary protein excretion (*B*), survival without end-stage renal disease (*ESRD*) (*C*), or the combined outcome of doubling of baseline serum creatinine concentration or ESRD (*D*) during follow-up among patients taking angiotensin-converting enzyme inhibitors (*ACEI*) (*dotted line*) and controls (*solid line*).



- Meta-analysis of RAAS blockade in CKD with protein>1g/d
- Improved renal and CV outcomes in those with proteinuria >1g (adjusted for BP)

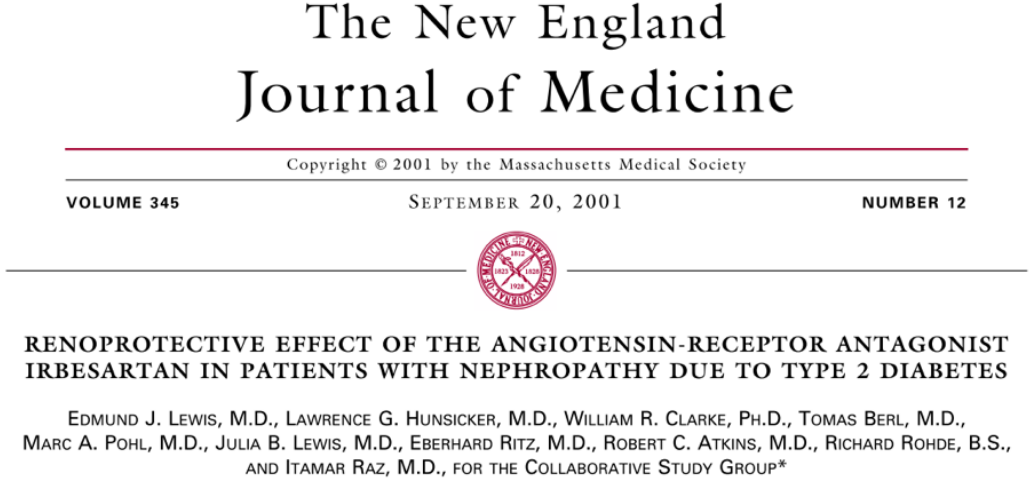
- Benefit of RAASi is more pronounced in those with **higher** degrees of proteinuria



The values above the graphs in panels A and B are the fraction of patients with events in the control group (*upper row*) and angiotensin-converting enzyme inhibitor group (*lower row*). Relative risks were calculated from multivariable models controlling for significant baseline patient and study characteristics. The solid horizontal line at a relative risk of 1.0 in panels C and D indicates no difference between the ACE inhibitor and control groups; the solid and dotted curved lines represent point estimates and 95% CIs for the relative risks. *P* values for tests for interaction between baseline urinary protein excretion and treatment were 0.03 and 0.001, respectively.

Diabetics: IDNT

- 1715 patients with DM2 and >900mg/d protein randomized 1:1:1 to irbesartan, amlodipine or placebo with doses of active drug titrated to blood pressure



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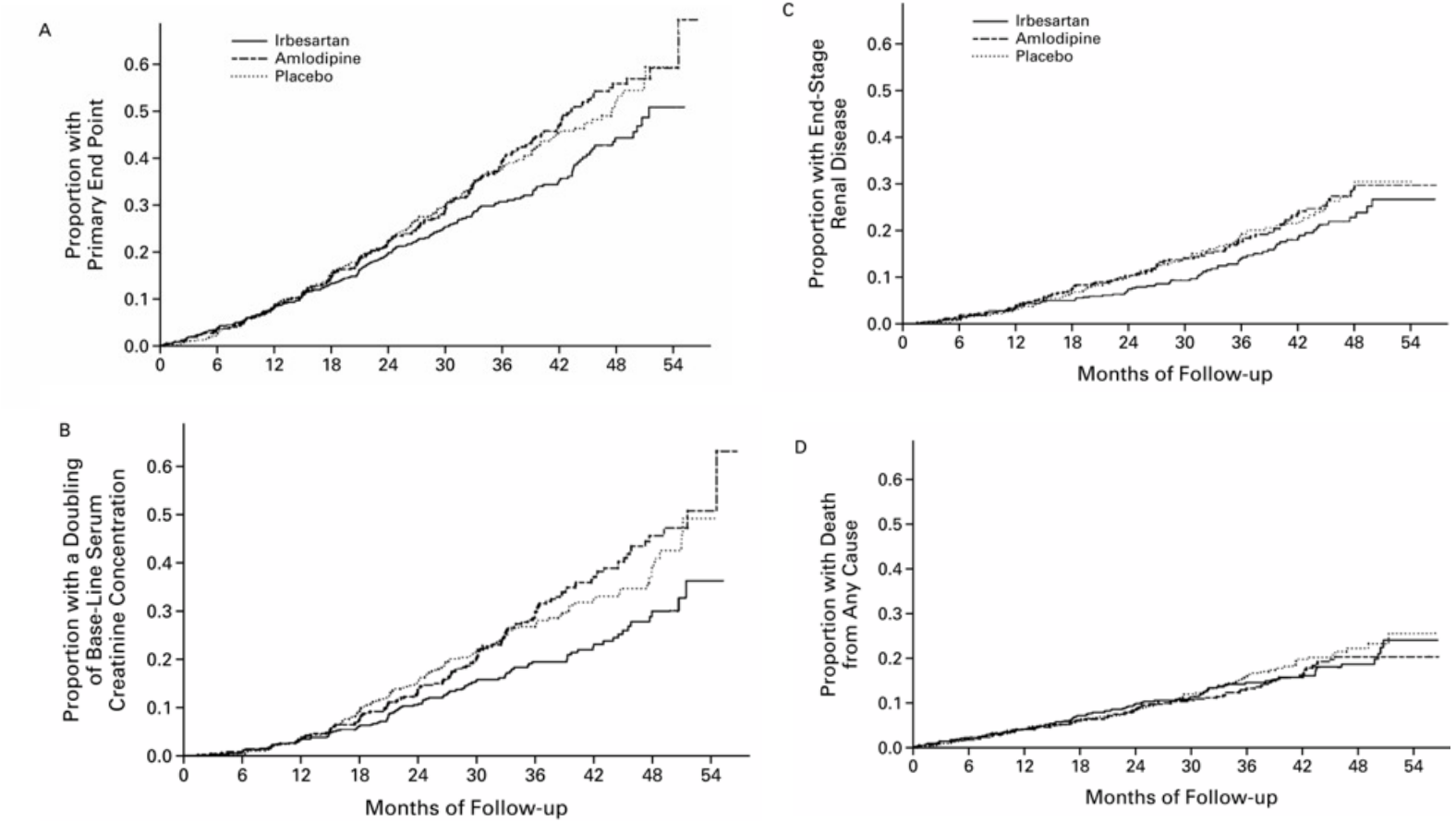
RENOPROTECTIVE EFFECT OF THE ANGIOTENSIN-RECEPTOR ANTAGONIST IRBESARTAN IN PATIENTS WITH NEPHROPATHY DUE TO TYPE 2 DIABETES

EDMUND J. LEWIS, M.D., LAWRENCE G. HUNSICKER, M.D., WILLIAM R. CLARKE, PH.D., TOMAS BERL, M.D., MARC A. POHL, M.D., JULIA B. LEWIS, M.D., EBERHARD RITZ, M.D., ROBERT C. ATKINS, M.D., RICHARD ROHDE, B.S., AND ITAMAR RAZ, M.D., FOR THE COLLABORATIVE STUDY GROUP*

Not shown here, but BP was similar across groups



RENAAL

EFFECTS OF LOSARTAN ON RENAL AND CARDIOVASCULAR OUTCOMES IN PATIENTS WITH TYPE 2 DIABETES AND NEPHROPATHY

BARRY M. BRENNER, M.D., MARK E. COOPER, M.D., PH.D., DICK DE ZEEUW, M.D., PH.D., WILLIAM F. KEANE, M.D., WILLIAM E. MITCH, M.D., HANS-HENRIK PARVING, M.D., GIUSEPPE REMUZZI, M.D., STEVEN M. SNAPINN, PH.D., ZHONXIN ZHANG, PH.D., AND SHAHNAZ SHAHINFAR, M.D., FOR THE RENAAL STUDY INVESTIGATORS*

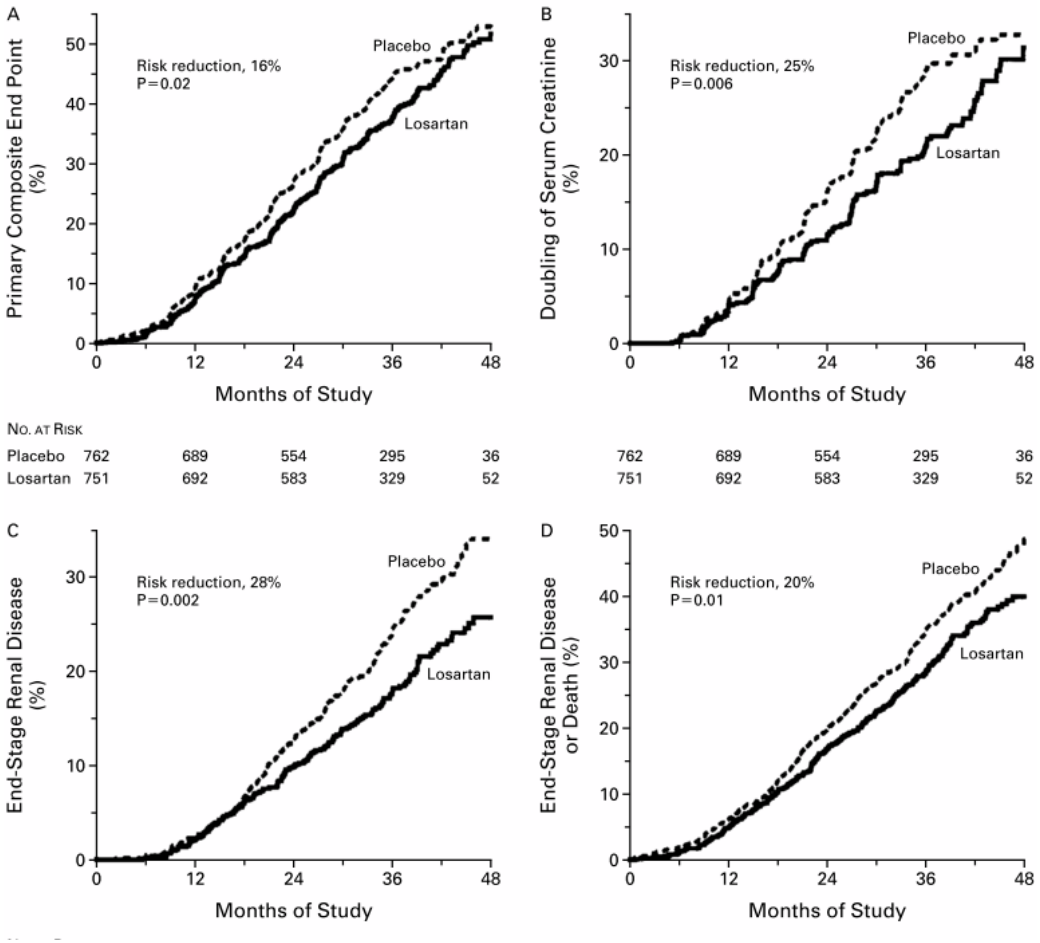
- 327 patients with DM2 and >500mg proteinuria randomized to either losartan or any antihypertensive, both titrated to 140/90

ACR ~140 mg/mmol in our units

TABLE 1. BASE-LINE CHARACTERISTICS OF THE PATIENTS.*

CHARACTERISTIC	LOSARTAN GROUP (N=751)	PLACEBO GROUP (N=762)
Age — yr	60±7	60±7
Sex — no. (%)		
Male	462 (61.5)	494 (64.8)
Female	289 (38.5)	268 (35.2)
Race or ethnic group — no. (%)		
Asian	117 (15.6)	135 (17.7)
Black	125 (16.6)	105 (13.8)
White	358 (47.7)	378 (49.6)
Hispanic	140 (18.6)	136 (17.8)
Other	11 (1.5)	8 (1.0)
Body-mass index†	30±6	29±6
Blood pressure — mm Hg		
Systolic	152±19	153±20
Diastolic	82±10	82±11
Mean arterial‡	105.5±10.9	106.0±11.6
Pulse§	69.4±17.4	70.8±18.1
Medical history — no. (%)		
Use of antihypertensive drugs	693 (92.3)	721 (94.6)
Angina pectoris	65 (8.7)	75 (9.8)
Myocardial infarction	75 (10.0)	94 (12.3)
Coronary revascularization procedure	1 (0.1)	1 (0.1)
Stroke	0	1 (0.1)
Lipid disorder	234 (31.2)	271 (35.6)
Amputation	65 (8.7)	69 (9.1)
Neuropathy	375 (49.9)	379 (49.7)
Retinopathy	494 (65.8)	470 (61.7)
Current smoking	147 (19.6)	130 (17.1)
Laboratory variables		
Median urinary albumin:creatinine ratio	1237	1261
Serum creatinine — mg/dl¶	1.9±0.5	1.9±0.5
Serum cholesterol — mg/dl‖		
Total	227±56	229±55
Low-density lipoprotein	142±47	142±45
High-density lipoprotein	45±16	45±15
Serum triglycerides — mg/dl**	213±180	225±200
Hemoglobin — g/dl††	12.5±1.9	12.5±1.8
Glycosylated hemoglobin — %	8.5±1.7	8.4±1.6

EFFECTS OF LOSARTAN ON RENAL AND CARDIOVASCULAR OUTCOMES IN TYPE 2 DIABETES AND NEPHROPATHY



- Not shown here but BP was not significantly different between the two groups for the duration of the study

Grading of CKD BP guidelines

Note where the **strong** evidence is and where the weaker statements are

In the CKD world, the stronger evidence for lower targets is those with high proteinuria

- KDIGO extrapolates SPRINT but many of the CKD groups were excluded

With better renal and cardiac outcomes, the grading for RAASi is stronger for proteinuric patients than non-proteinuric CKD

- You can extrapolate to others (and there are other reasons for RAASi –eg HOPE), but in the renal world these are the patients to be more aggressive with RAASi

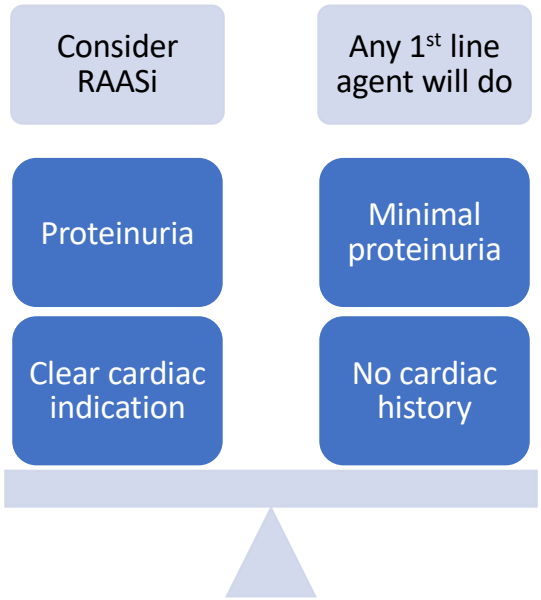
Pre-SPRINT

	<30mg/24h	30-300mg	>300mg
Diabetic	140/90 **(1B)**	130/80 (2D) Use ACE/ARB (2D)	130/80 (2D) Use ACE/ARB **(1B)**
Non-Diabetic	140/90 **(1B)**	130/80 (2C) Use ACE/ARB (2D)	130/80 (2C) Use ACE/ARB **(1B)**

Post-SPRINT

Recommendation 3.1.1: We suggest that adults with high BP and CKD be treated with a target systolic blood pressure (SBP) of <120 mm Hg, when tolerated, using standardized office BP measurement (*2B*).

Putting it all together: to RAASi or not to RAASi?



Potential benefits: CV outcomes in those with established cardiac issues, better renal outcomes in some subgroups

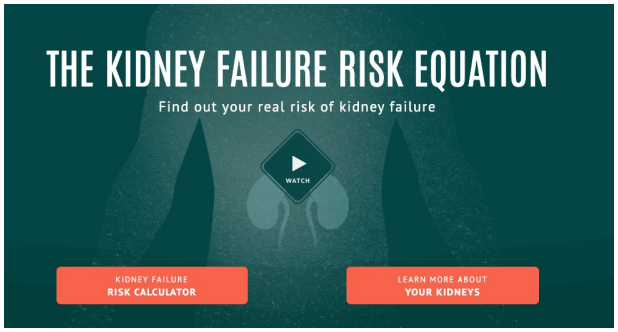
Potential risks: Potentiation of AKIs, hyperkalemia

Drugs should always be individualized

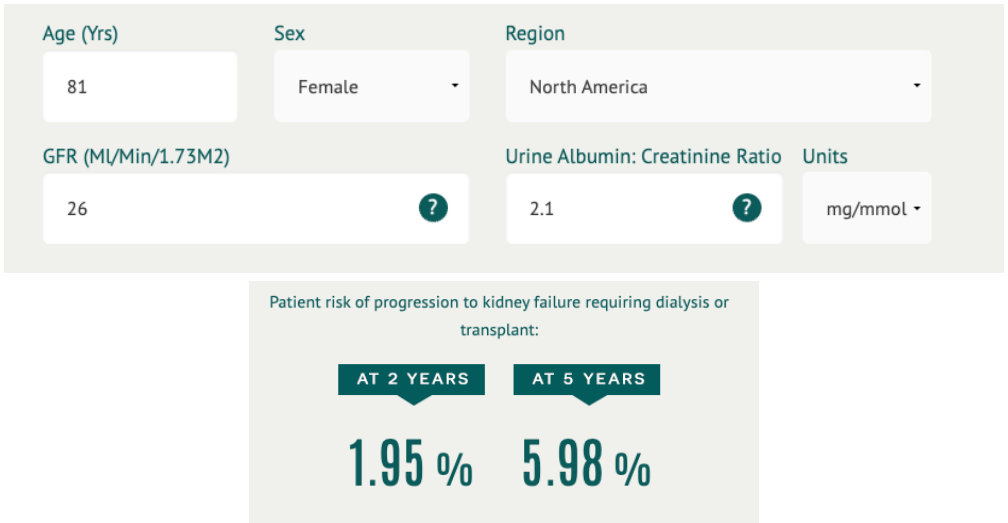
- RAASi is a good choice for almost everyone
- But if you run into trouble, consider what the evidence was for RAASi and consider if you think risk outweighs the benefit
  - I think of these as 'negotiable' and 'non-negotiable' reasons for RAASi

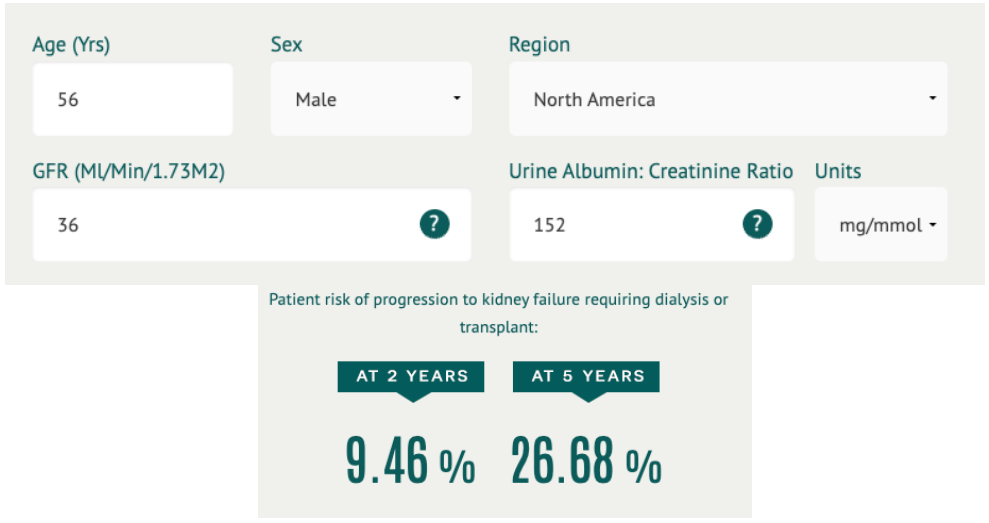
Final consideration when selecting treatments for renal protection

Ask yourself: What is the chance this intervention will change the patient's renal outcome?



kidneyfailurerisk.com

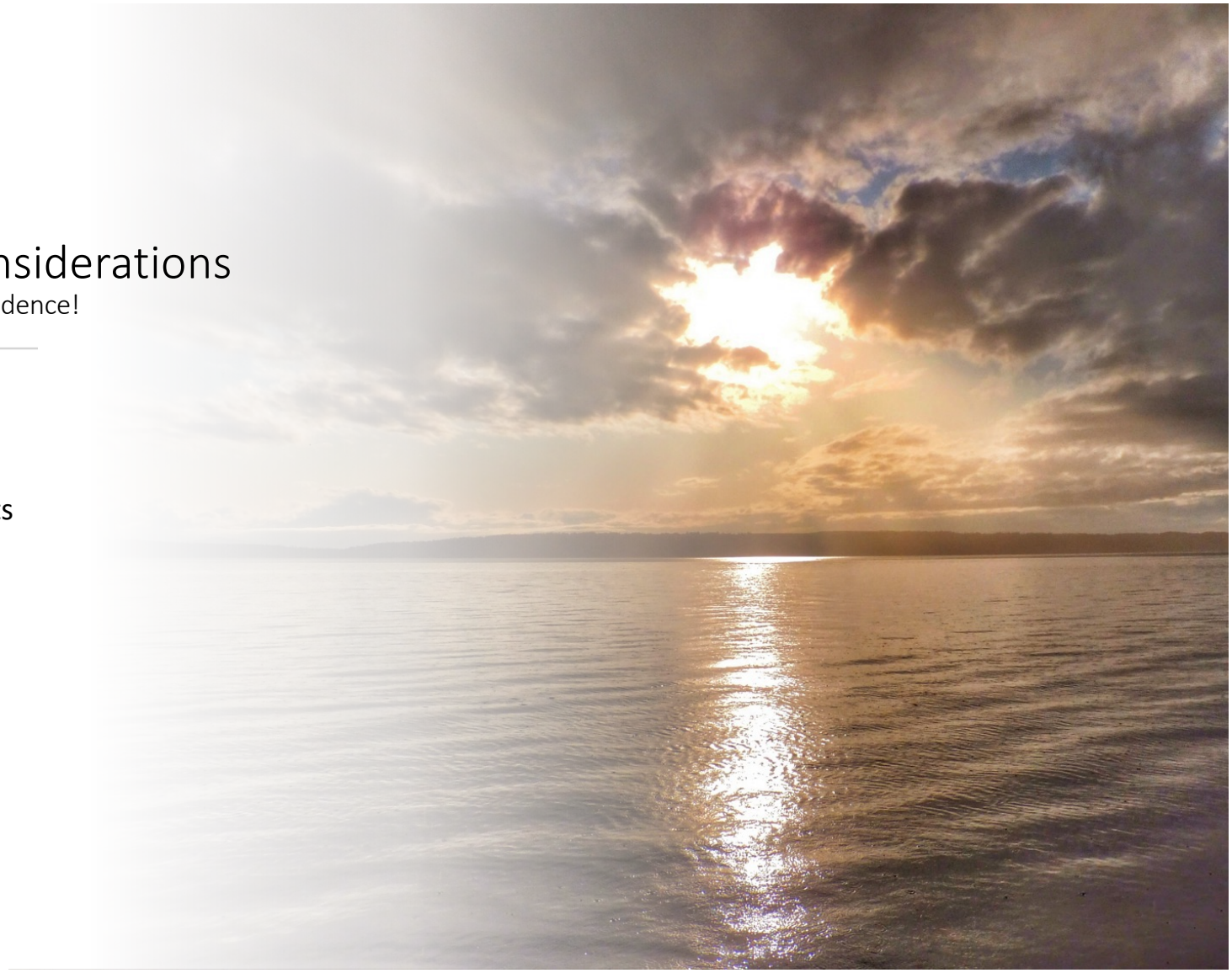




Other management considerations

You made it through the whirlwind of evidence!

- Lifestyle changes
- Proper BP measurement
- Sick day medication adjustments



Health Behaviour Recommendations

Objective	Recommendation	Application
Being More Physically Active	An accumulation of 30-60 minutes of dynamic exercise of moderate intensity (such as walking, cycling, swimming) 4-7 days per week in addition to the routine activities of daily living. Higher intensities of exercise are no more effective at BP lowering. For non-hypertensive or hypertensive individuals with SBP/DBP of 140-159/90-99 mmHg, the use of resistance or weight training exercise (such as free weight lifting, fixed weight lifting, or hand grip exercise) does not adversely influence BP.	Prescribe to both normotensive and hypertensive individuals for prevention and management of hypertension, respectively.
Weight Reduction	A healthy BMI (18.5 – 24.9 kg/m²) and waist circumference (<102 cm for men and <88 cm for women) is recommended for non-hypertensive individuals to prevent hypertension and for hypertensive patients to reduce BP.	Encourage multidisciplinary approach to weight loss, including dietary education, increased physical activity, and behaviour modification.
Moderation in Alcohol Intake	To prevent hypertension, abstain, as there is no safe limit for alcohol consumption. Patients with hypertension should abstain from, or limit alcohol consumption to <2 drinks per day to lower blood pressure.	Prescribe to normotensive and hypertensive individuals for prevention and management of hypertension, respectively.
Eating Healthier	DASH-like diet: • High in fresh fruits, vegetables, dietary fibre, non-animal protein (e.g., soy) and low-fat dairy products. Low in saturated fat and cholesterol. • To decrease BP in hypertensive patients, consider increasing dietary potassium.	Prescribe to both normotensive and hypertensive individuals for the prevention and management of hypertension, respectively.
Relaxation Therapies	Individualized cognitive behaviour interventions are more likely to be effective when relaxation techniques are employed.	Prescribe for selected patients in whom stress plays a role in elevating BP.
Smoking Cessation	Advise smokers to quit and offer them specific pharmacotherapy to help them quit. Abstinence from smoking. A smoke-free environment.	Global cardiovascular risk reduction strategy.

Lifestyle adjustments

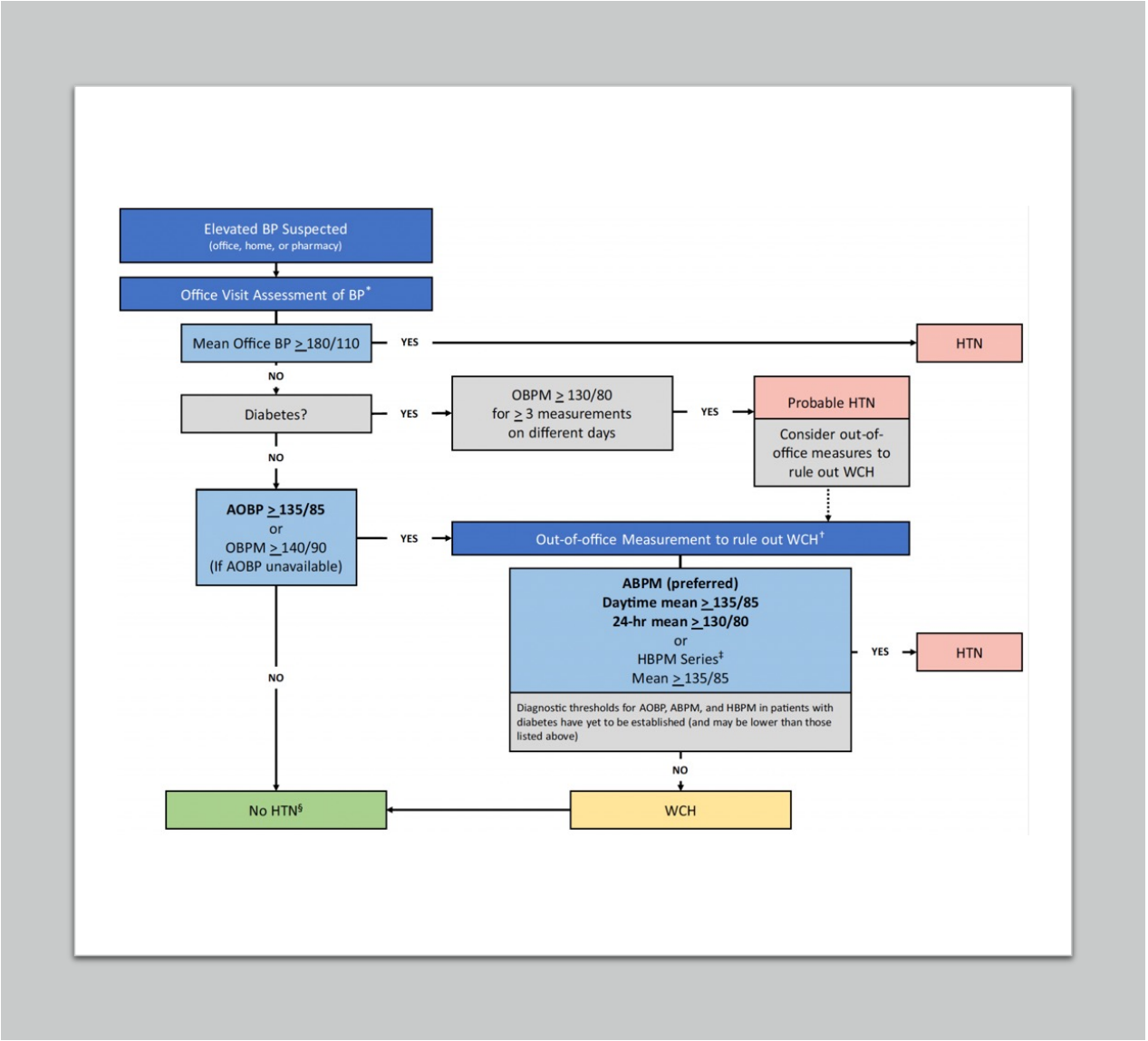
Note about salt:

- Debate over limit for the general population, not all BP is salt sensitive, but in general the lower the better when you are thinking of hypertensive CKD patients

Hypertension CANADA

Home vs office based BP measurement

- Out of office BP assessment is the preferred method for ***diagnosis*** of HTN as it is ***superior to*** office based measurements
- Evidence base is building for monitoring but not as strong as for diagnosis



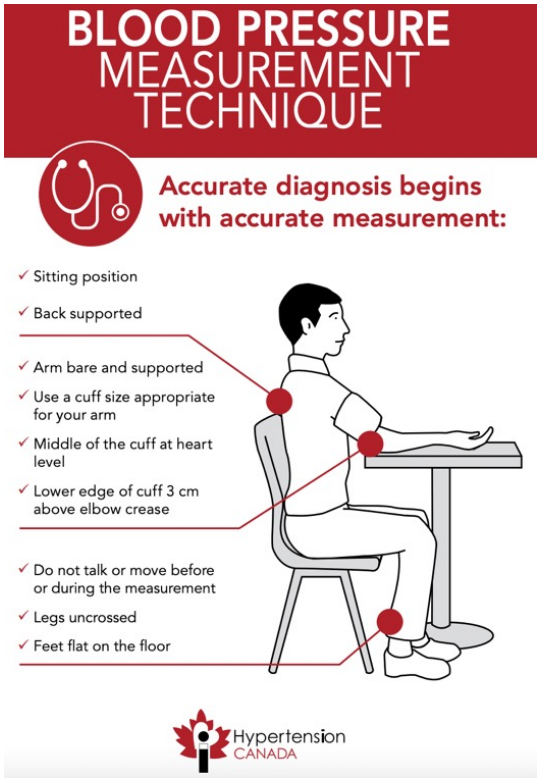
Office based BP measurement

Acronym	Definition	
AOBP	Automated Office Blood Pressure is performed using an automated device that can take a series of oscillometric measurements without the provider or others present. The patient is left unattended in a private area while 3-6 oscillometric, consecutive readings are taken.	Preferred method of in-office measurement.
OBPM	Office Blood Pressure Measurement is performed using an upper arm device with the provider in the room. Oscillometric or electronic devices are preferred when using this method. Auscultatory – mercury or aneroid – devices are an alternative if an electronic device is not available.	
ABPM	Ambulatory Blood Pressure Monitoring requires the use of a validated oscillometric device which must be worn by the patient for a 24-hour period, with measurements taken at 20- to 30-minute intervals.	Preferred out-of-office method for diagnosis
HBPM	Home Blood Pressure Monitoring is a self-monitoring method which requires the patient to measure their blood pressure twice in the morning and evening for 7 days.	

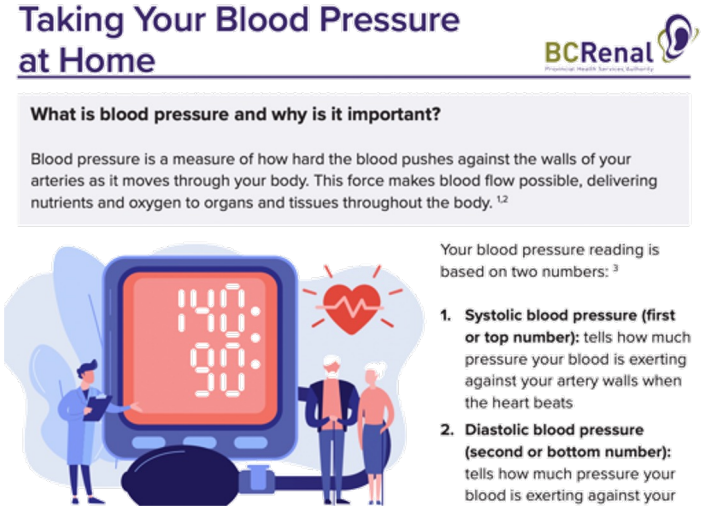
- If you are measuring in office, automated is better than manual (and preferably several averaged readings)

Automated Office (unattended, AOBP)
Oscillometric (electronic)

Home BP monitoring



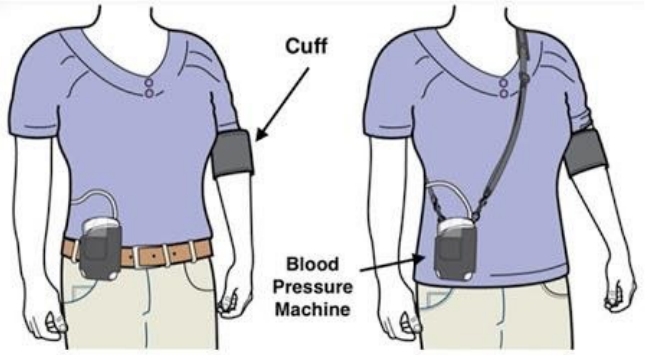
Available at www.hypertension.ca

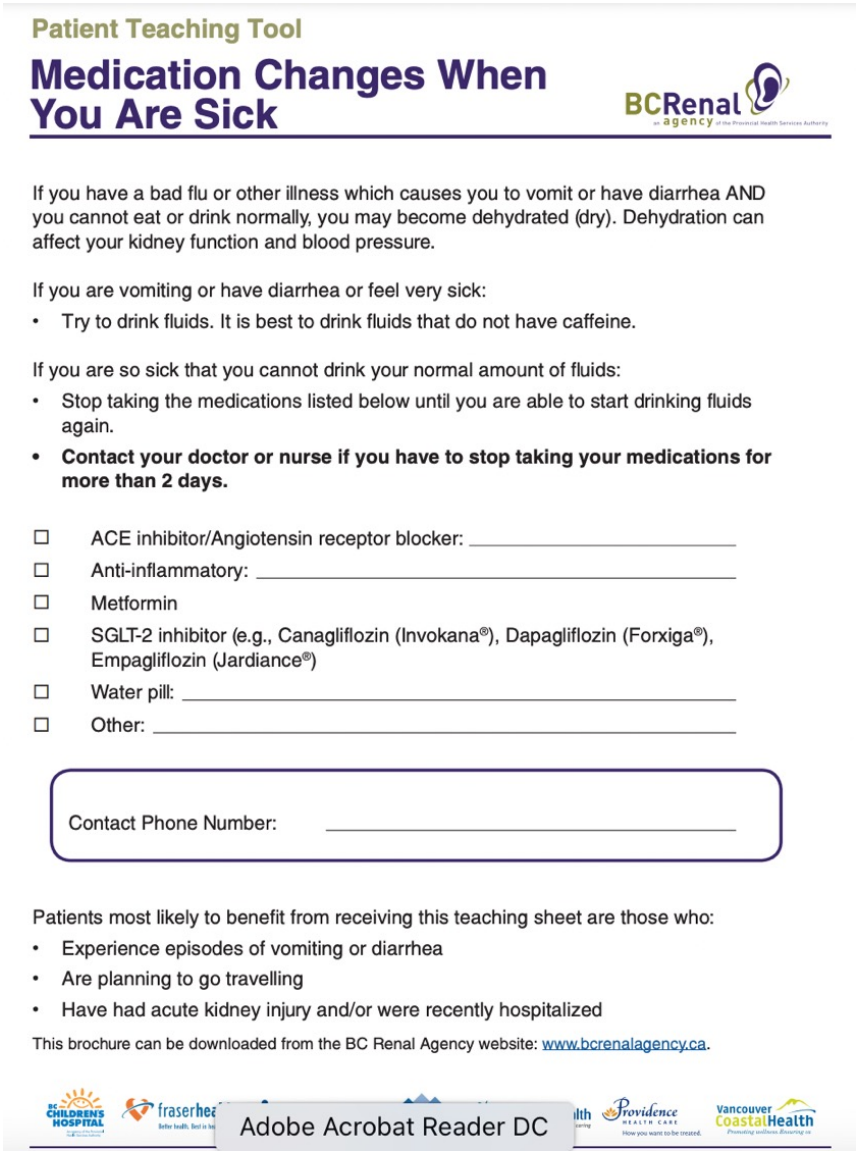


Available at www.bcrenal.ca

If doing home BP monitoring please direct patients to resources to ensure it is being done properly

24 ambulatory monitoring is the gold standard but also comes at a cost (One time cost similar to buying a home BP unit)





Patient Teaching Tool

Medication Changes When You Are Sick

BCRenal agency

If you have a bad flu or other illness which causes you to vomit or have diarrhea AND you cannot eat or drink normally, you may become dehydrated (dry). Dehydration can affect your kidney function and blood pressure.

If you are vomiting or have diarrhea or feel very sick:

- Try to drink fluids. It is best to drink fluids that do not have caffeine.

If you are so sick that you cannot drink your normal amount of fluids:

- Stop taking the medications listed below until you are able to start drinking fluids again.
- **Contact your doctor or nurse if you have to stop taking your medications for more than 2 days.**

- ☐ ACE inhibitor/Angiotensin receptor blocker: _____
- ☐ Anti-inflammatory: _____
- ☐ Metformin
- ☐ SGLT-2 inhibitor (e.g., Canagliflozin (Invokana®), Dapagliflozin (Forxiga®), Empagliflozin (Jardiance®)
- ☐ Water pill: _____
- ☐ Other: _____

Contact Phone Number: _____

Patients most likely to benefit from receiving this teaching sheet are those who:

- Experience episodes of vomiting or diarrhea
- Are planning to go travelling
- Have had acute kidney injury and/or were recently hospitalized

This brochure can be downloaded from the BC Renal Agency website: www.bcrenalagency.ca.

Adobe Acrobat Reader DC

Last pointer:

- I would suggest any patient with any of these medications get a 'sick day list', especially those on multiple agents
- Similar strategy applies not just to being 'sick' but also in the setting of substantial/symptomatic hypotension

Outline and Objectives

Outline

- Epidemiology of HTN and CKD
- Evidence behind target BPs recommended in guidelines
  - Which targets apply to which patients
  - Who benefits from a lower target?
- Evidence behind choice of BP agent
  - Who needs RAASi?
- Other management considerations
  - Lifestyle interventions
  - Measuring BP
  - Sick day medication adjustments

Objectives

- Understand the interaction between HTN and CKD
- Understand where BP targets come from and how that applies to individual patients
- Understand the evidence behind choice of BP agents
- Understand proper methods for BP measurement in and out of office

Questions?