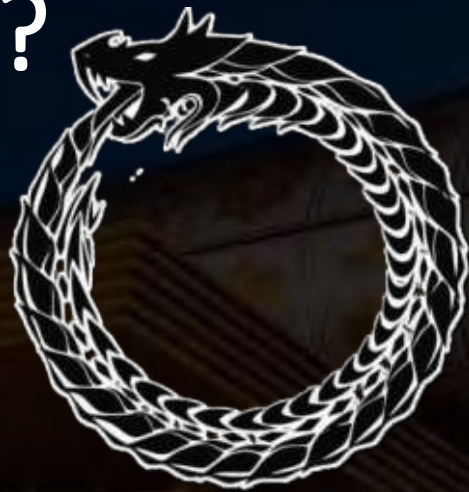


High blood pressure
and the kidney: the
first victim or the first
actor?



Nicolas Roberto Robles
Universidad de Salamanca
Spain

**INTERNATIONAL
HYPERTENSION
SYMPOSIUM MEETING**



SEPTEMBER 2024

HILTON HOTEL BAKU





HBP AND THE KIDNEY: KEY POINTS

Kidney causes “primary” hypertension

It is a symptom of renal diseases

It complicates renal failure

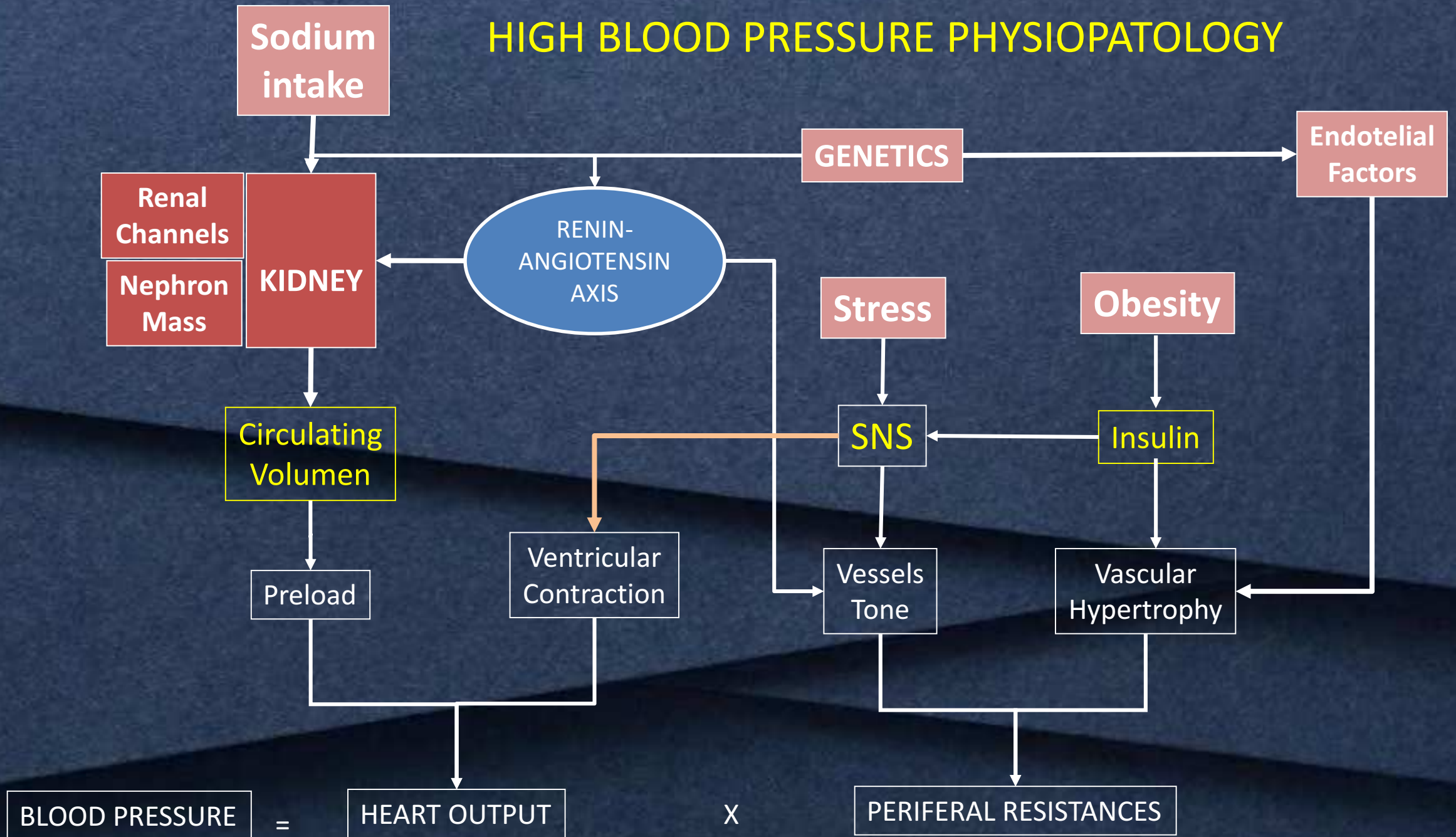
“Per se” it causes renal disease



HBP AND THE KIDNEY: KEY POINTS

**Kidney causes “primary”
hypertension**

HIGH BLOOD PRESSURE PHYSIOPATHOLOGY



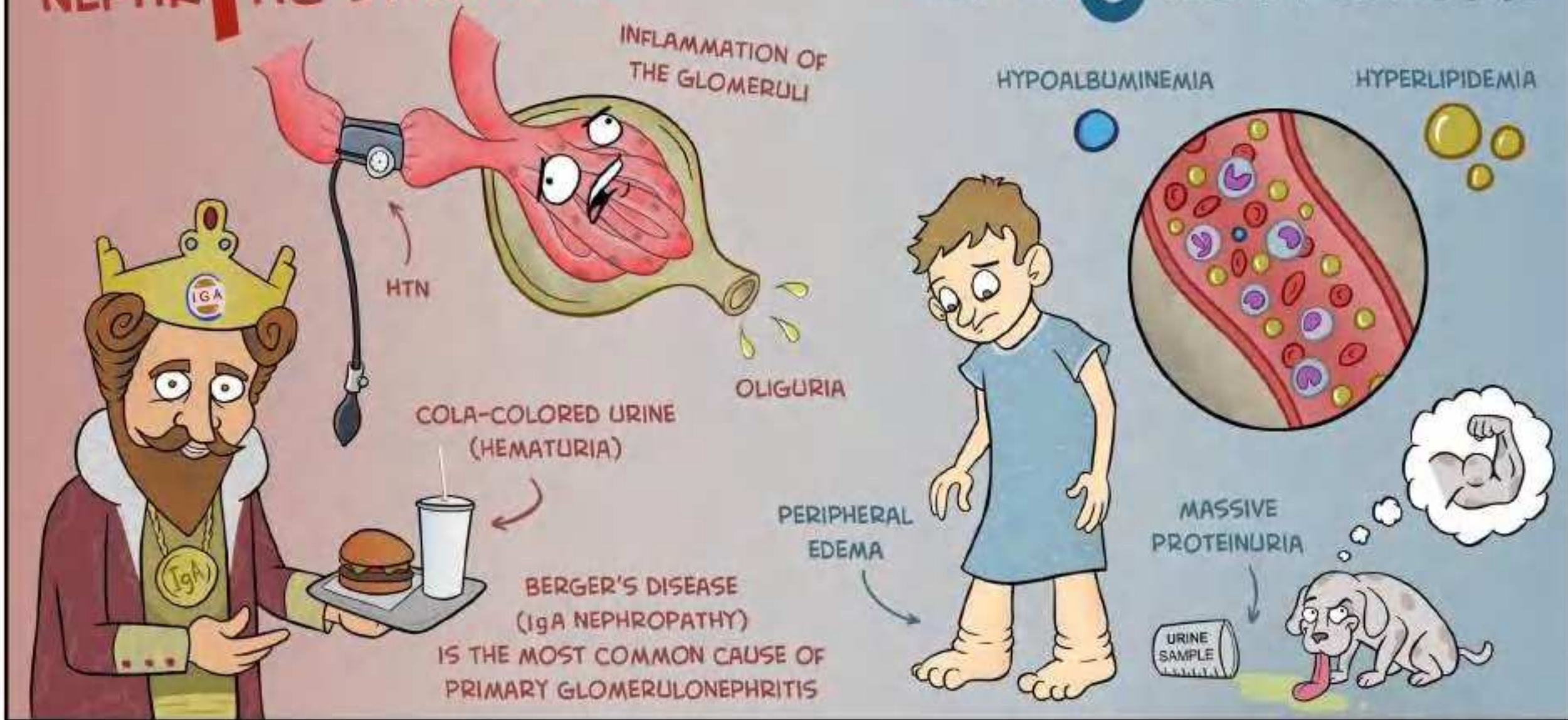


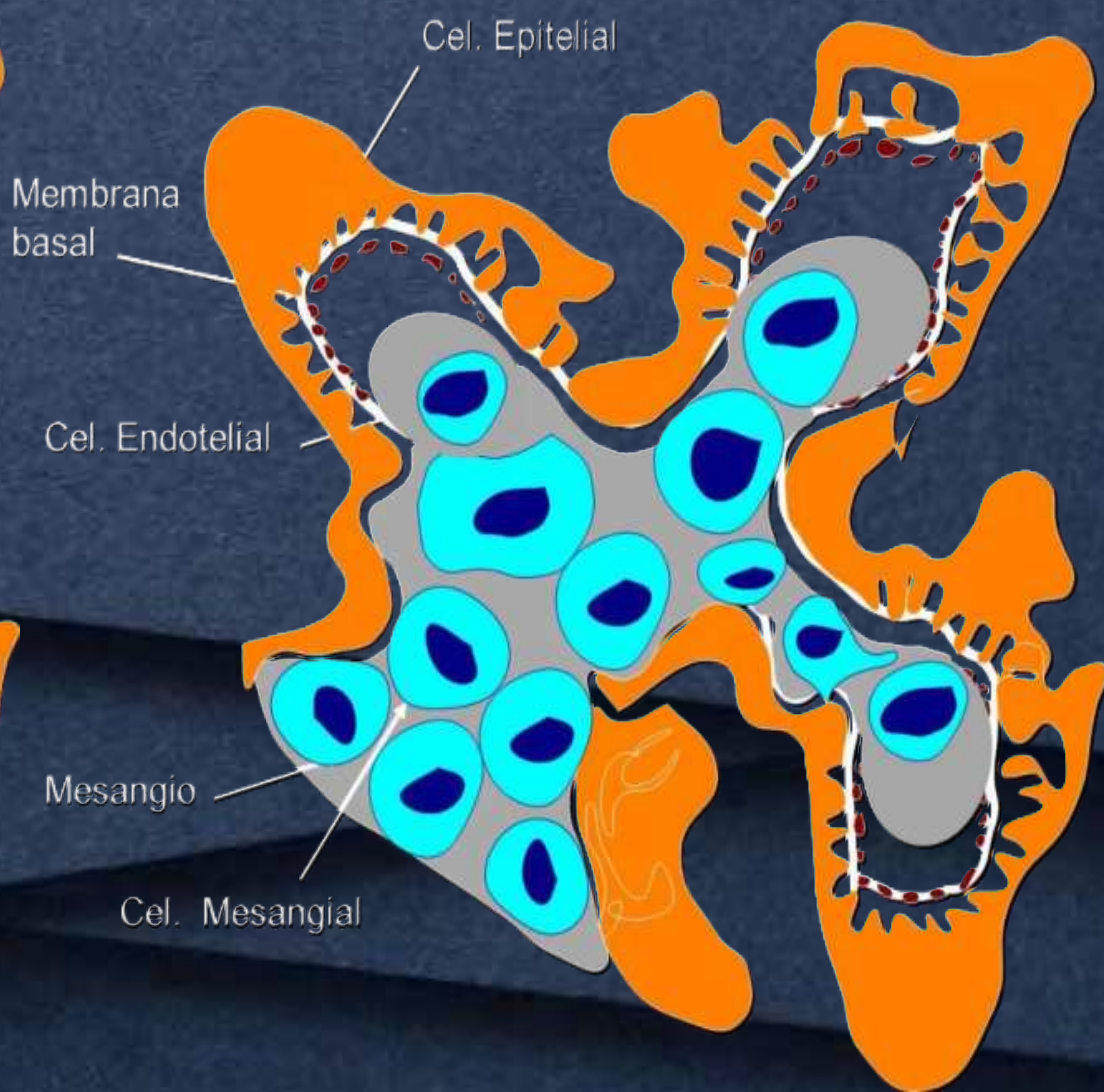
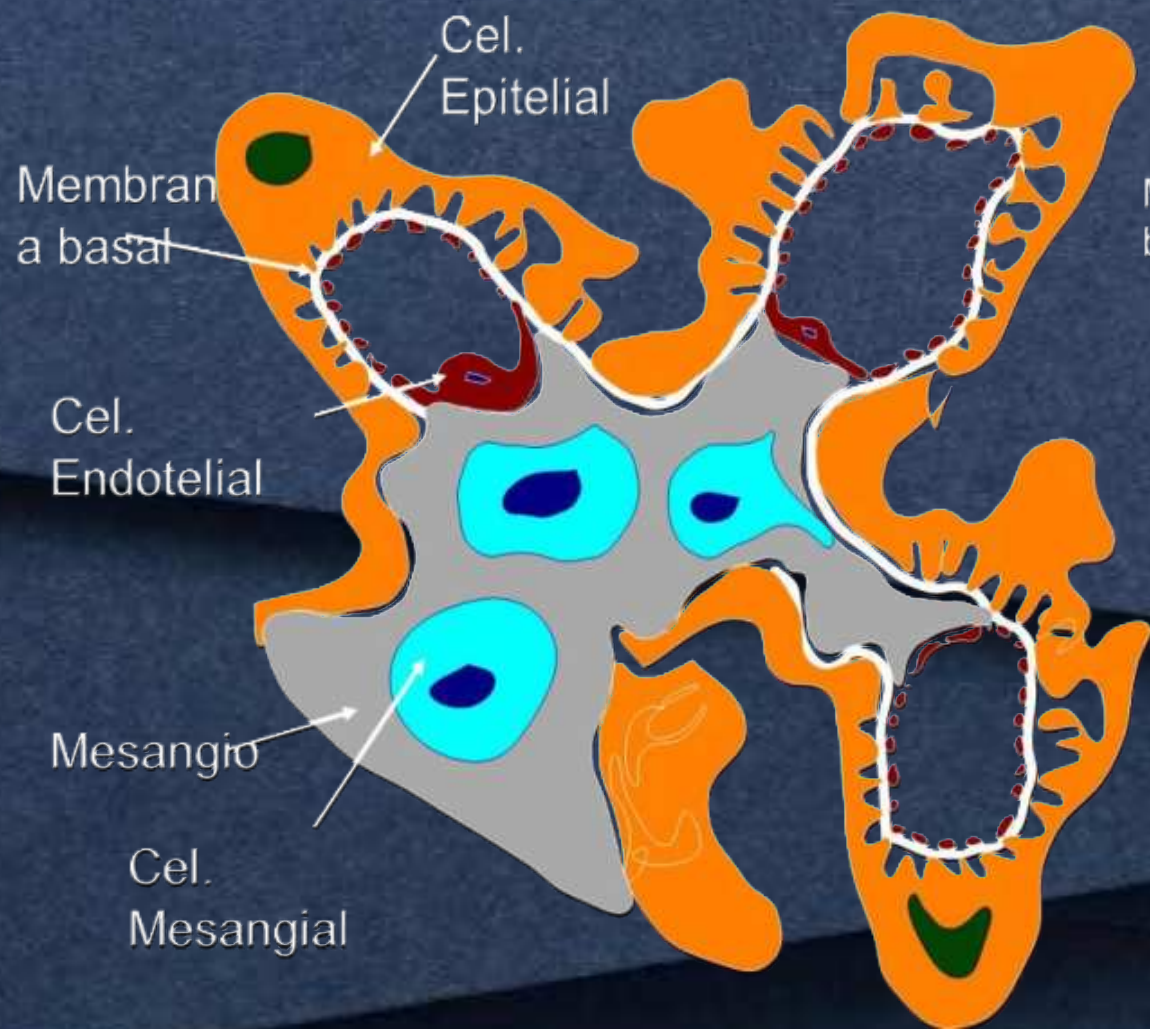
HBP AND THE KIDNEY: KEY POINTS

It is a sign of renal disease

NEPHRITIC SYNDROME

NEPHROTIC SYNDROME





PREVALENCE, AWARENESS, TREATMENT, AND CONTROL OF HYPERTENSION

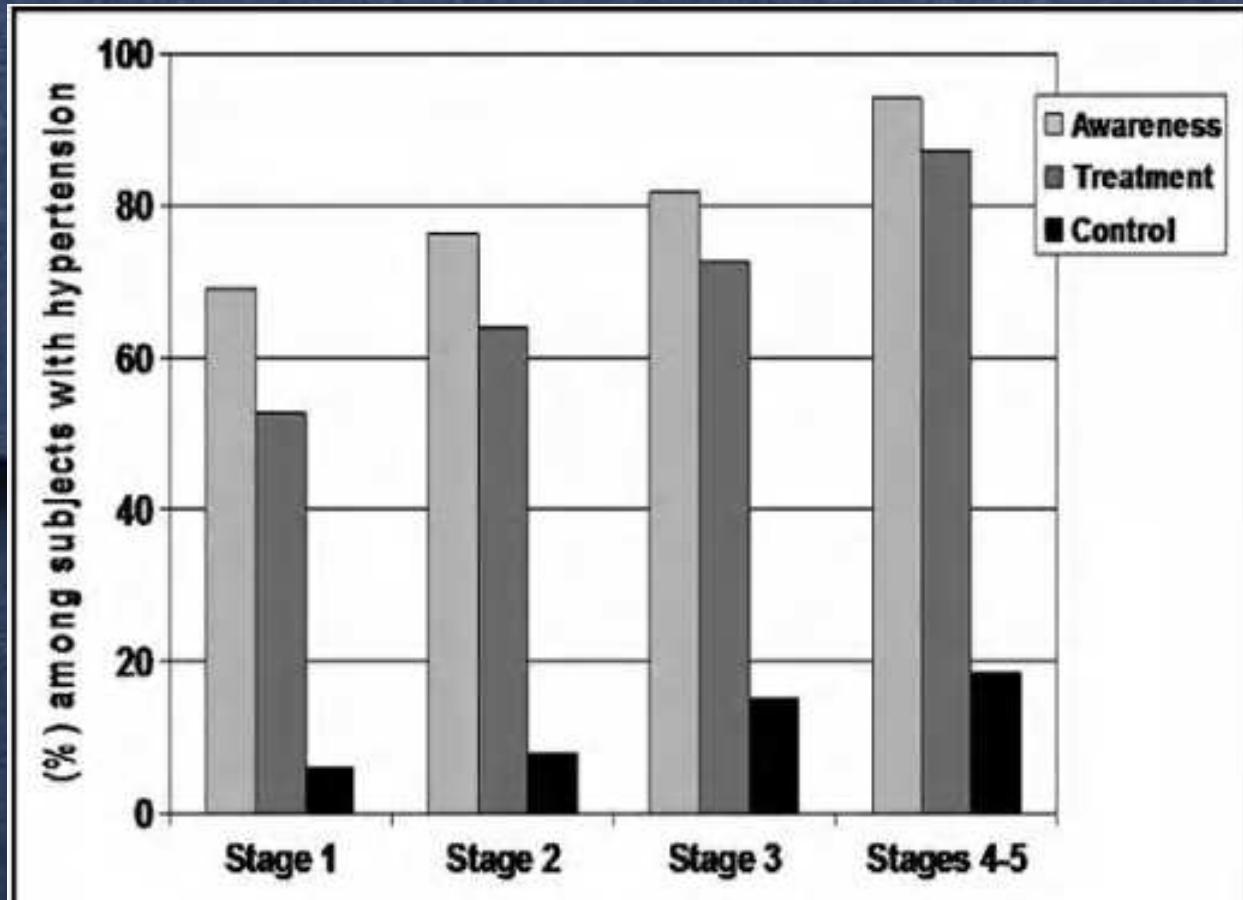


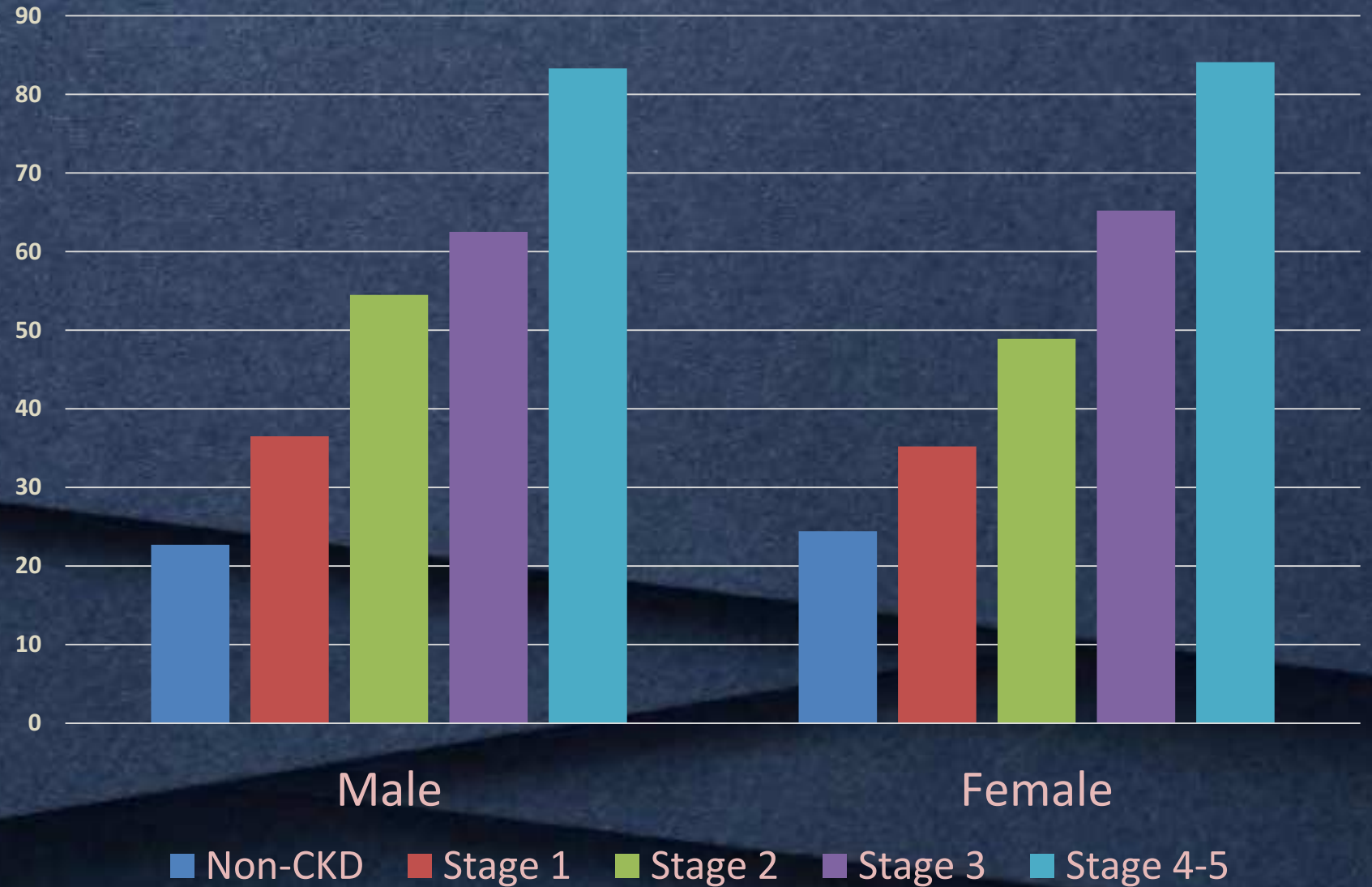
Table 3 Odds Ratios of Blood Pressure Control Among All Patients with Hypertension

Chronic kidney disease stage				
Stage 1 (ref)	1.00			
Stage 2	1.18	0.85	1.64	.33
Stage 3	2.22	1.66	2.98	<.0001
Stages 4 and 5	2.67	1.83	3.91	<.0001

OR = odds ratio; BMI = body mass index.

AWARENESS, TREATMENT, & CONTROL OF HYPERTENSION

NHANES 1999–2006
participants age 20 &
older



USRDS 2010

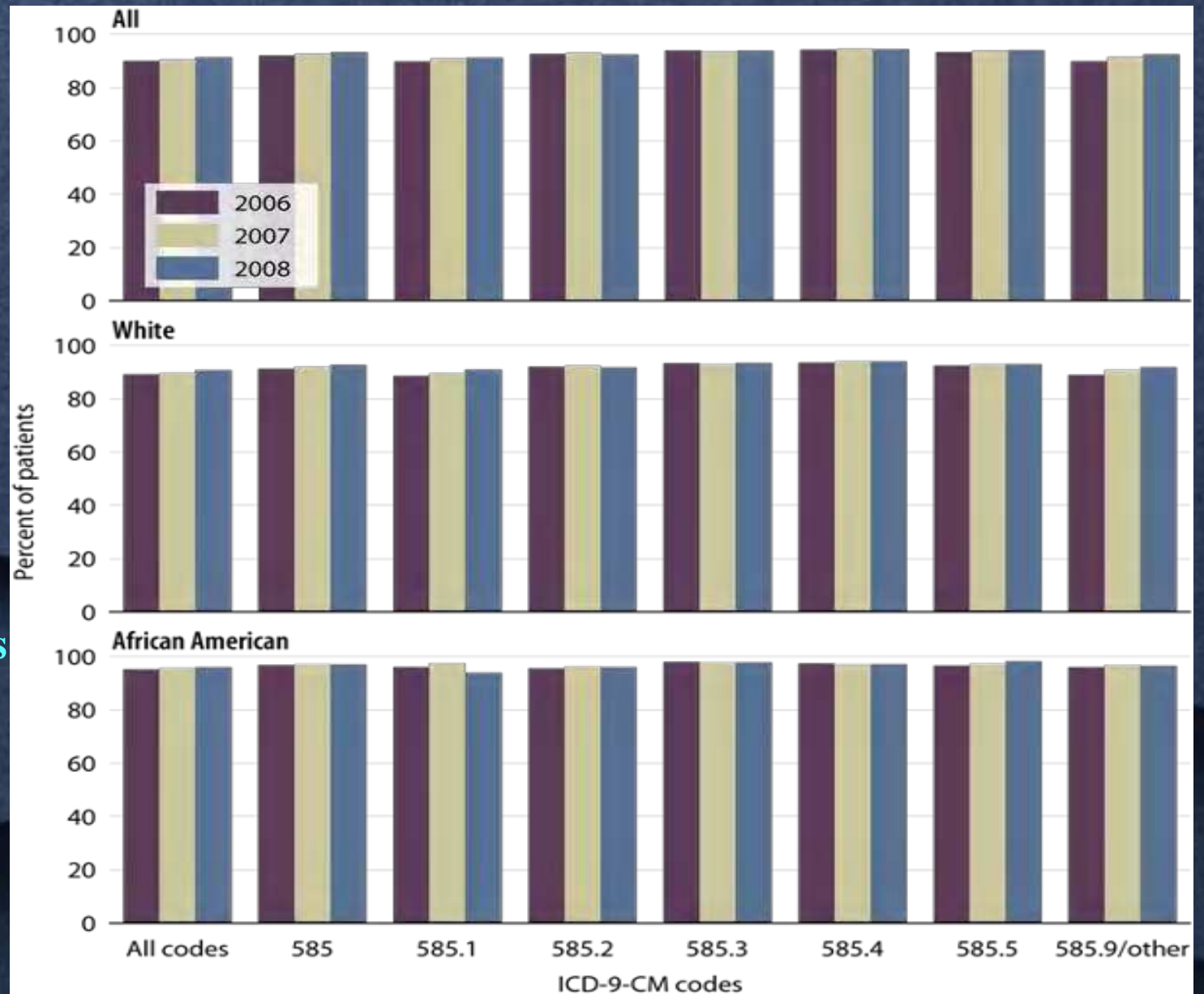


HBP AND THE KIDNEY: KEY POINTS

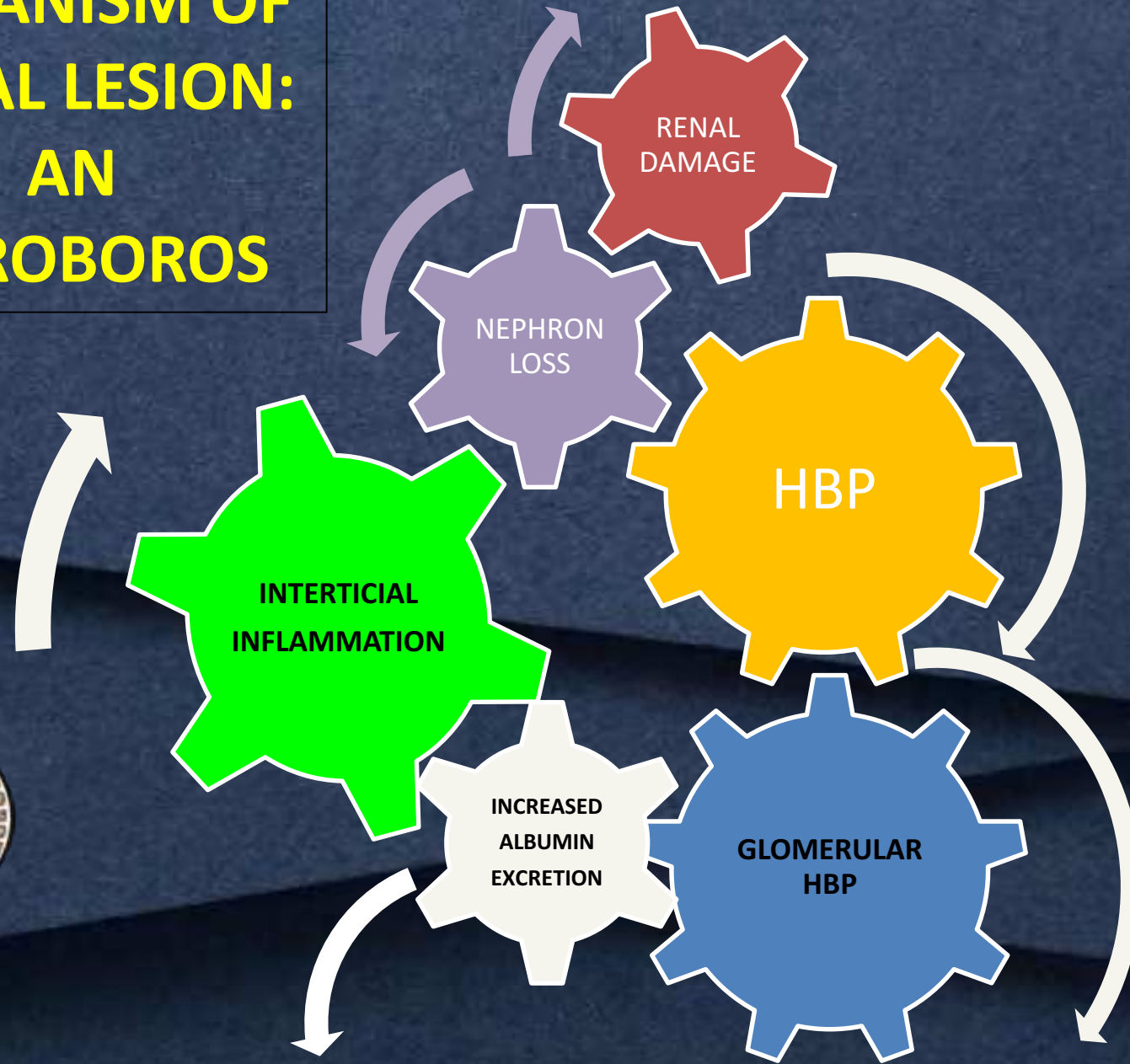
It complicates renal failure

Prevalence of hypertension, by diagnosis code, race, & year Table 2.19 (Volume 1)

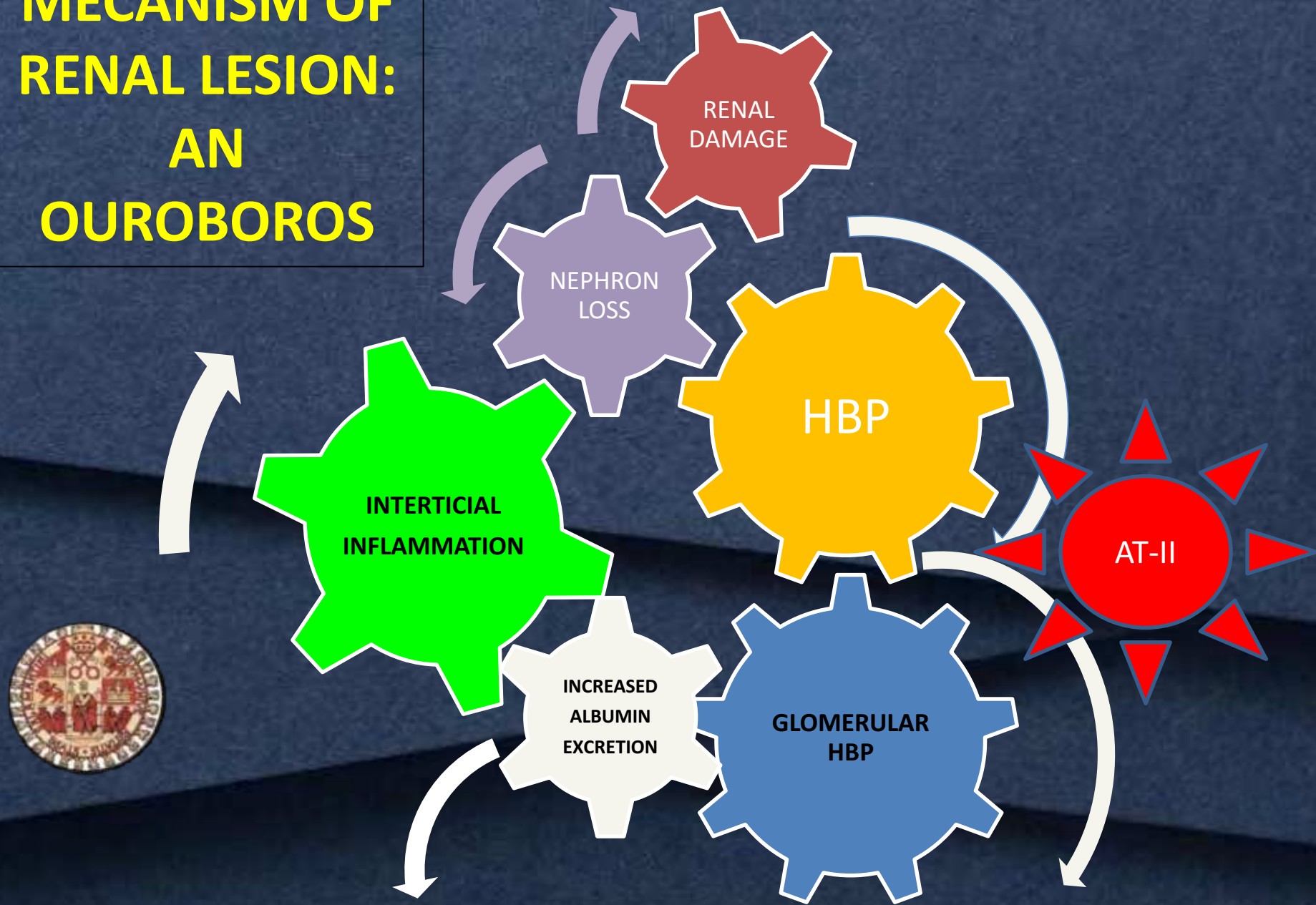
Medicare patients age 65 & older, surviving all of 2008; ESRD patients excluded.



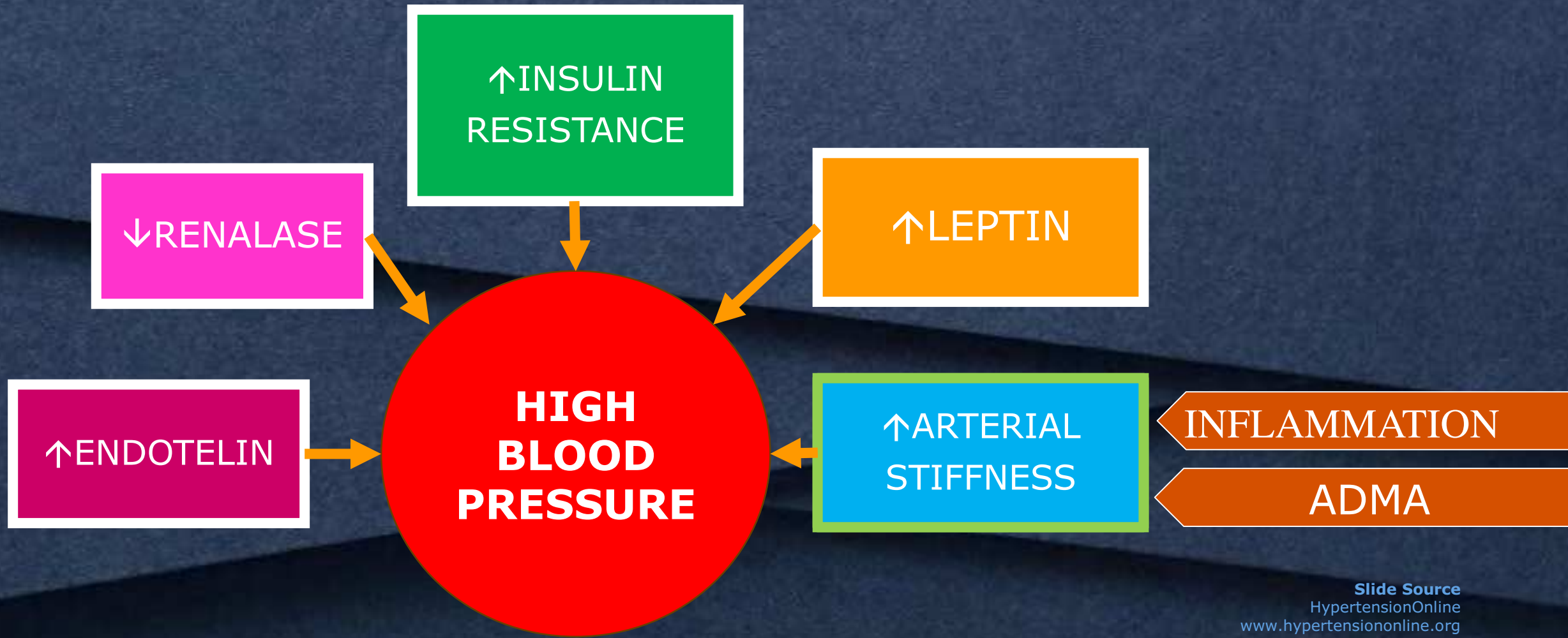
MECANISM OF RENAL LESION: AN OUROBOROS



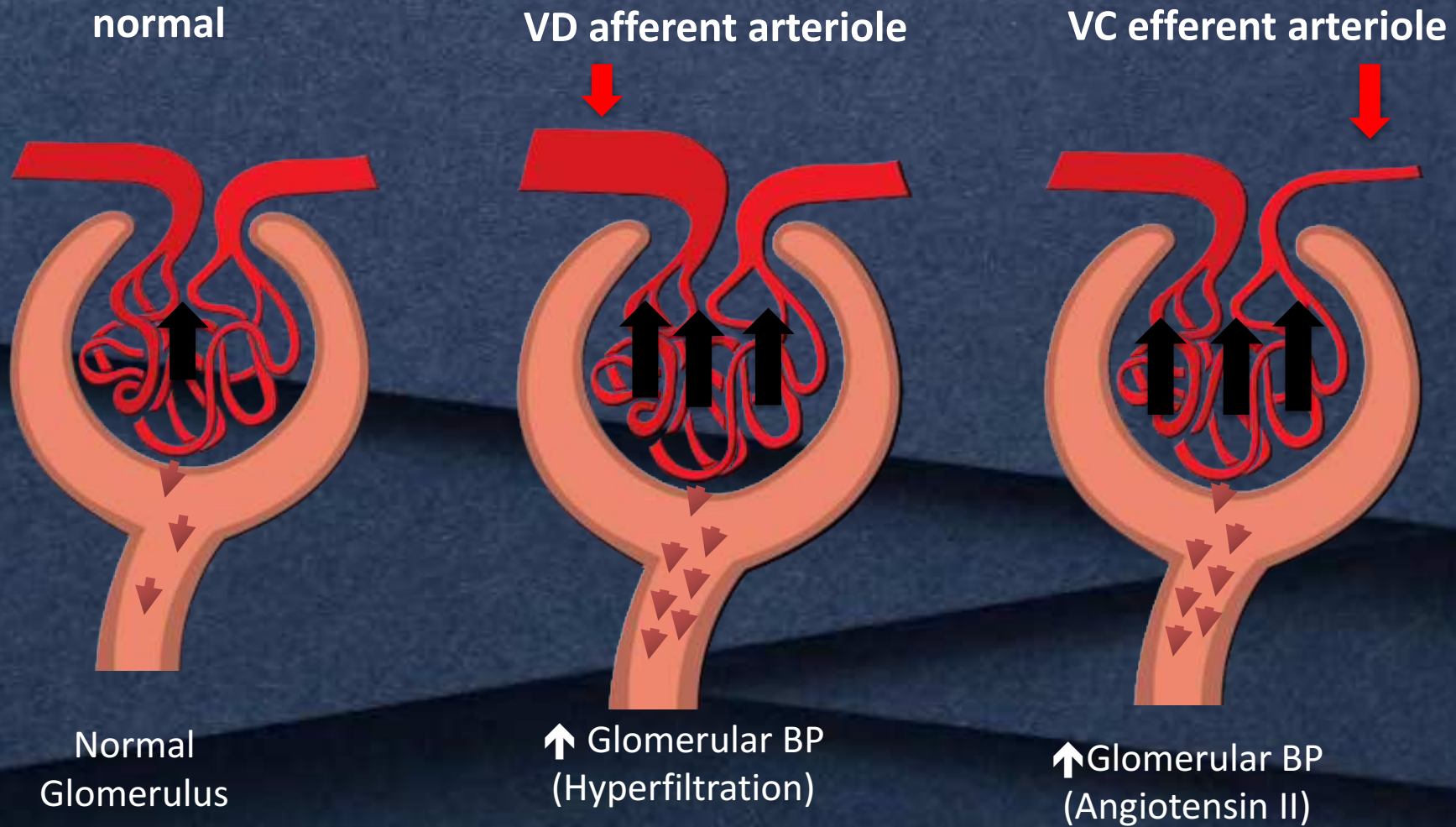
MECANISM OF RENAL LESION: AN OUROBOROS



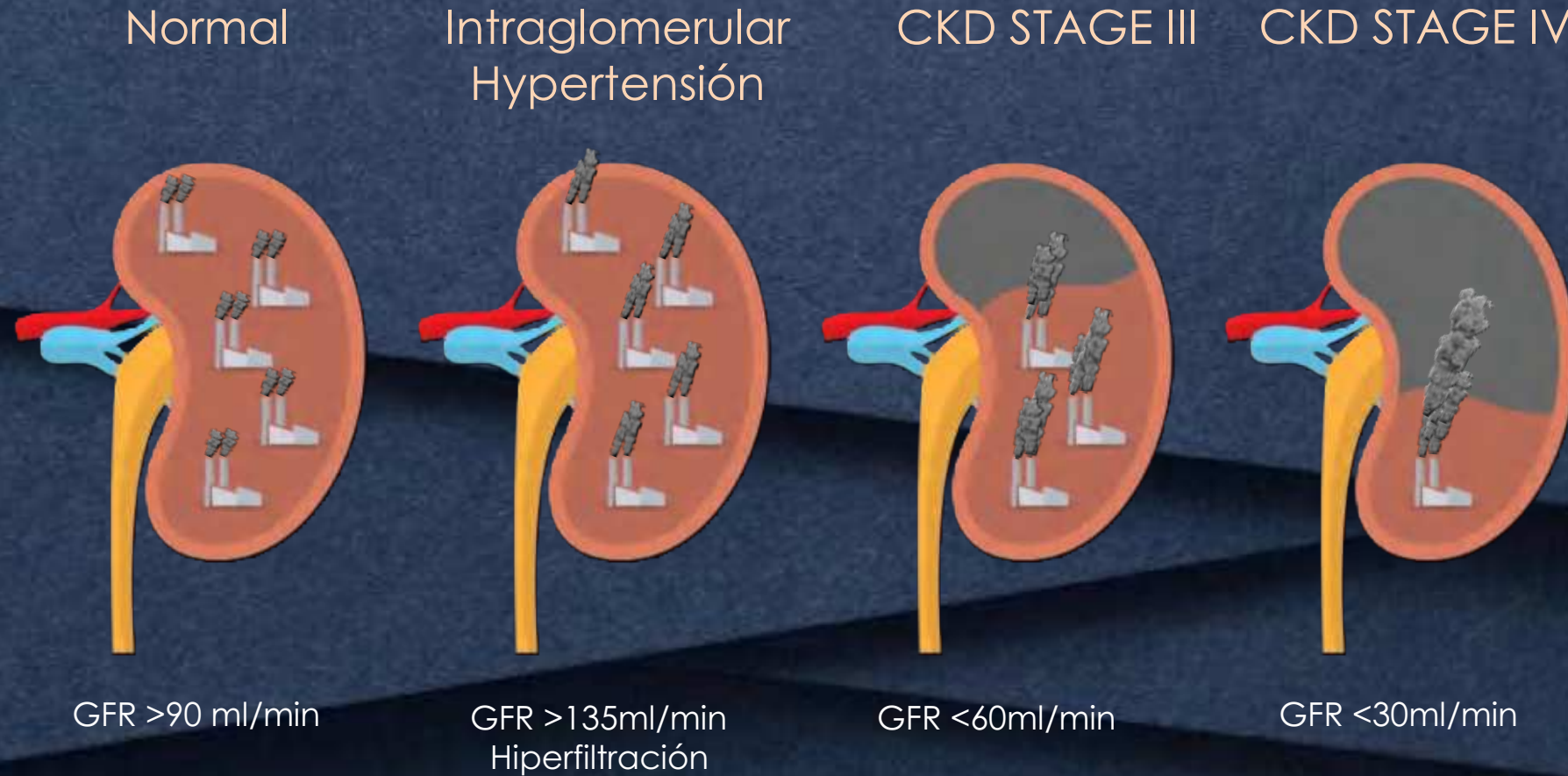
PATHOGENESIS OF HBP IN CKD



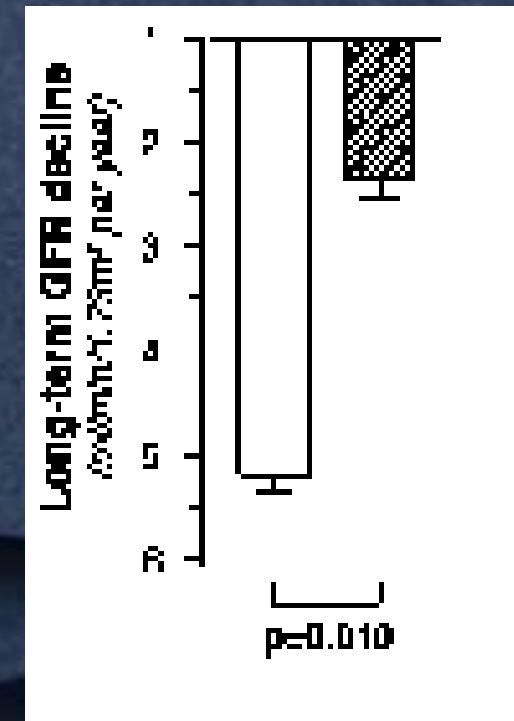
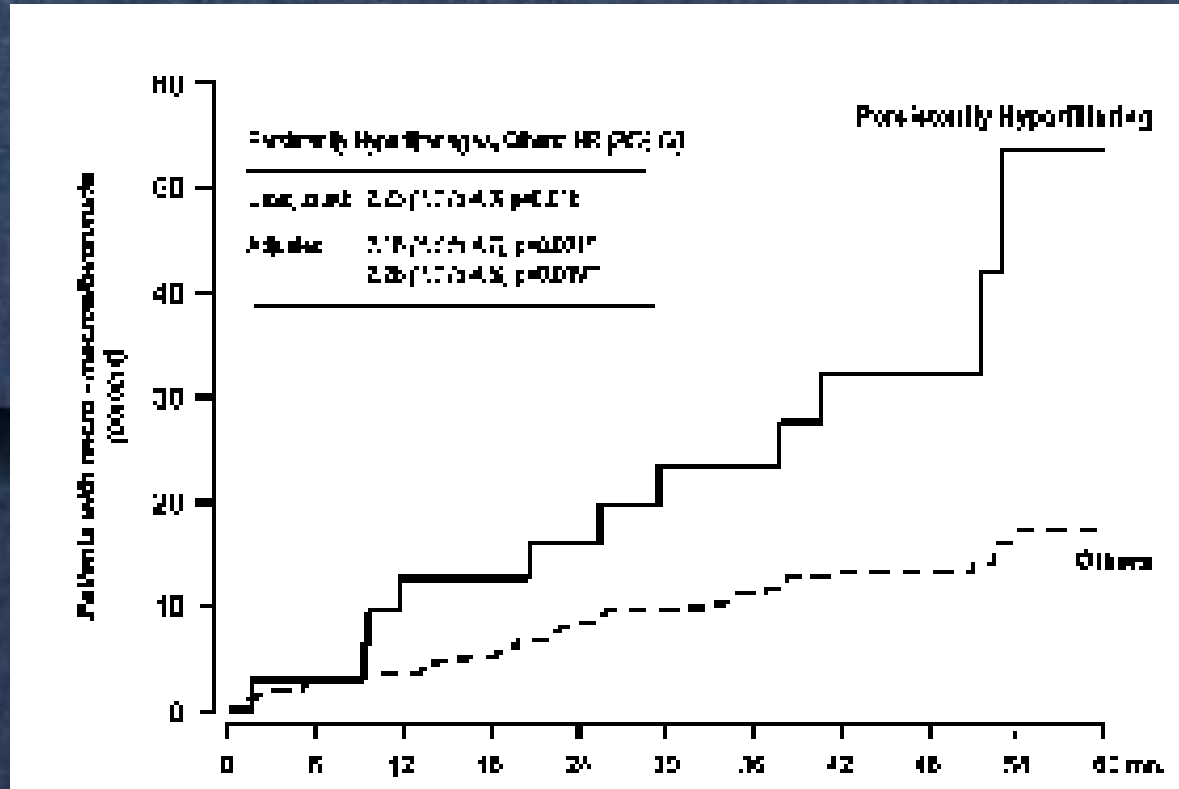
Glomerular Hemodynamics



INTRAGLOMERULAR BLOOD PRESSURE AND CKD PROGRESSION



HYPERFILTRATION AND CKD PROGRESSION RISK



Persistent hyperfiltration
 Ameliorated hyperfiltration

From BENEDICT and DEMAND trials. Iohexol plasma clearance

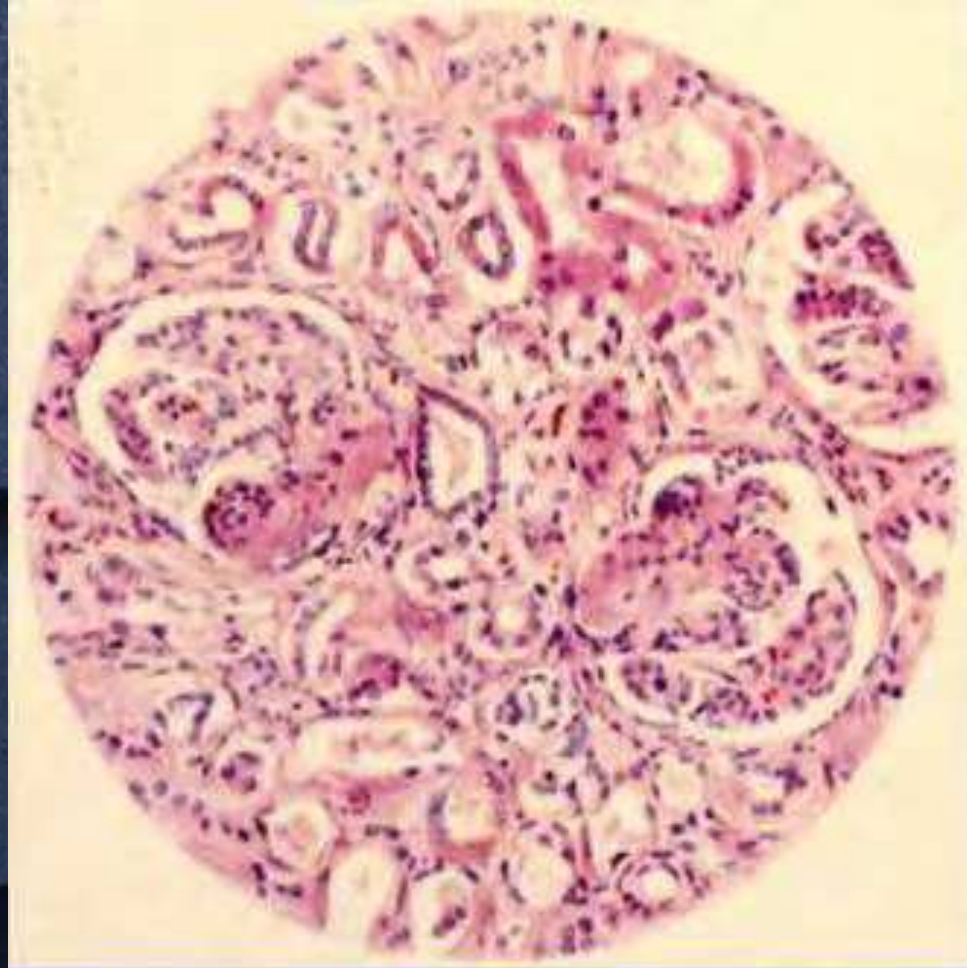
GFR reduction > 10% at month 6 were considered as patients with ameliorated hyperfiltration. Those with smaller reductions were categorized as “ persistently hyperfiltering.”



HBP AND THE KIDNEY: KEY POINTS

“Per se” it causes renal disease

ACCELERATED (MALIGNANT) HYPERTENSION



**Volhard F, Fahr KT. Die Brightsche Nierenkrankheit. Berlin.
Springer Verlag. 1914. Pp. 247-280.**

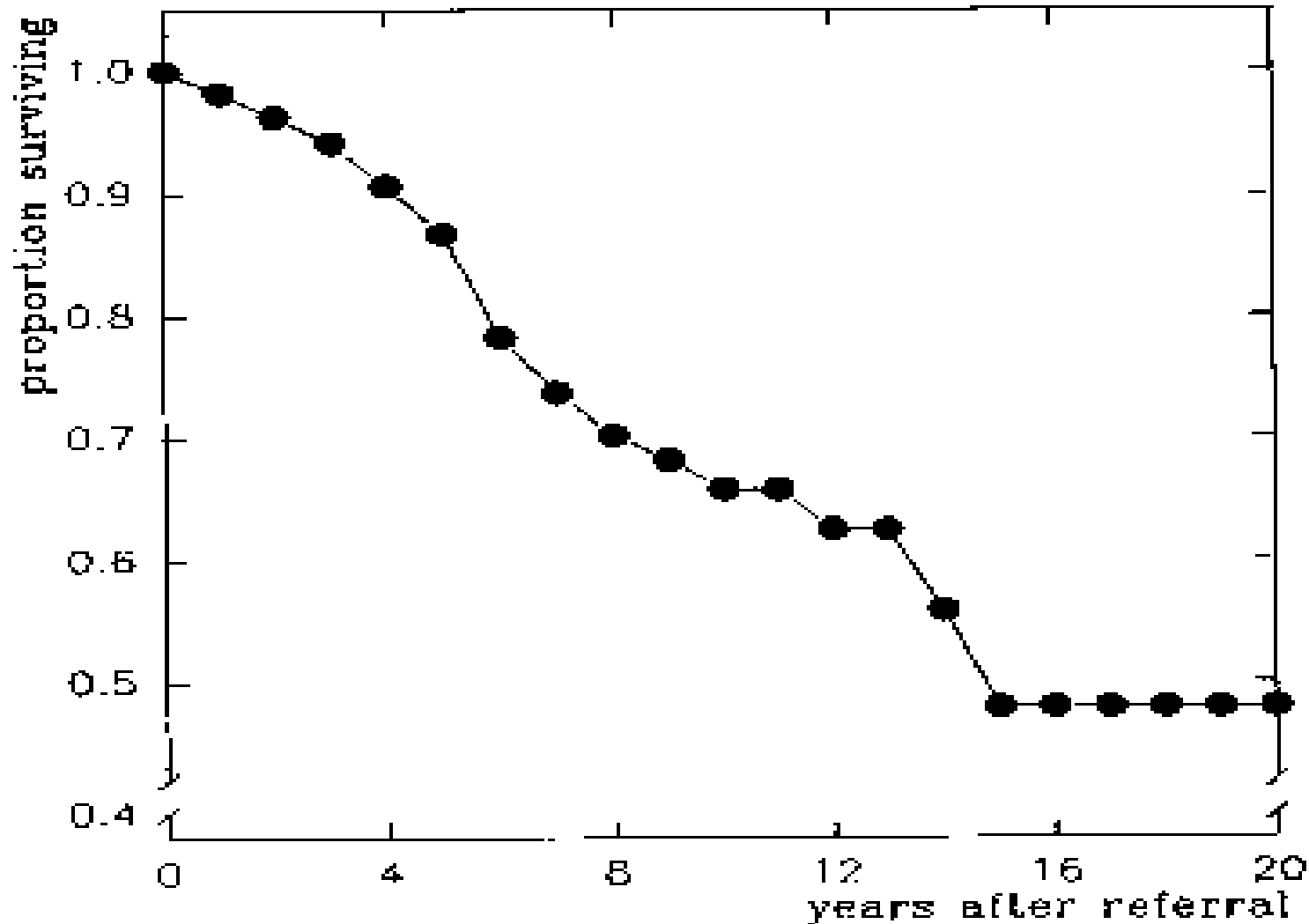


Figure 2. Cumulative proportions of patients with accelerated hypertension surviving at yearly intervals after referral, estimated by the actuarial life-table method.



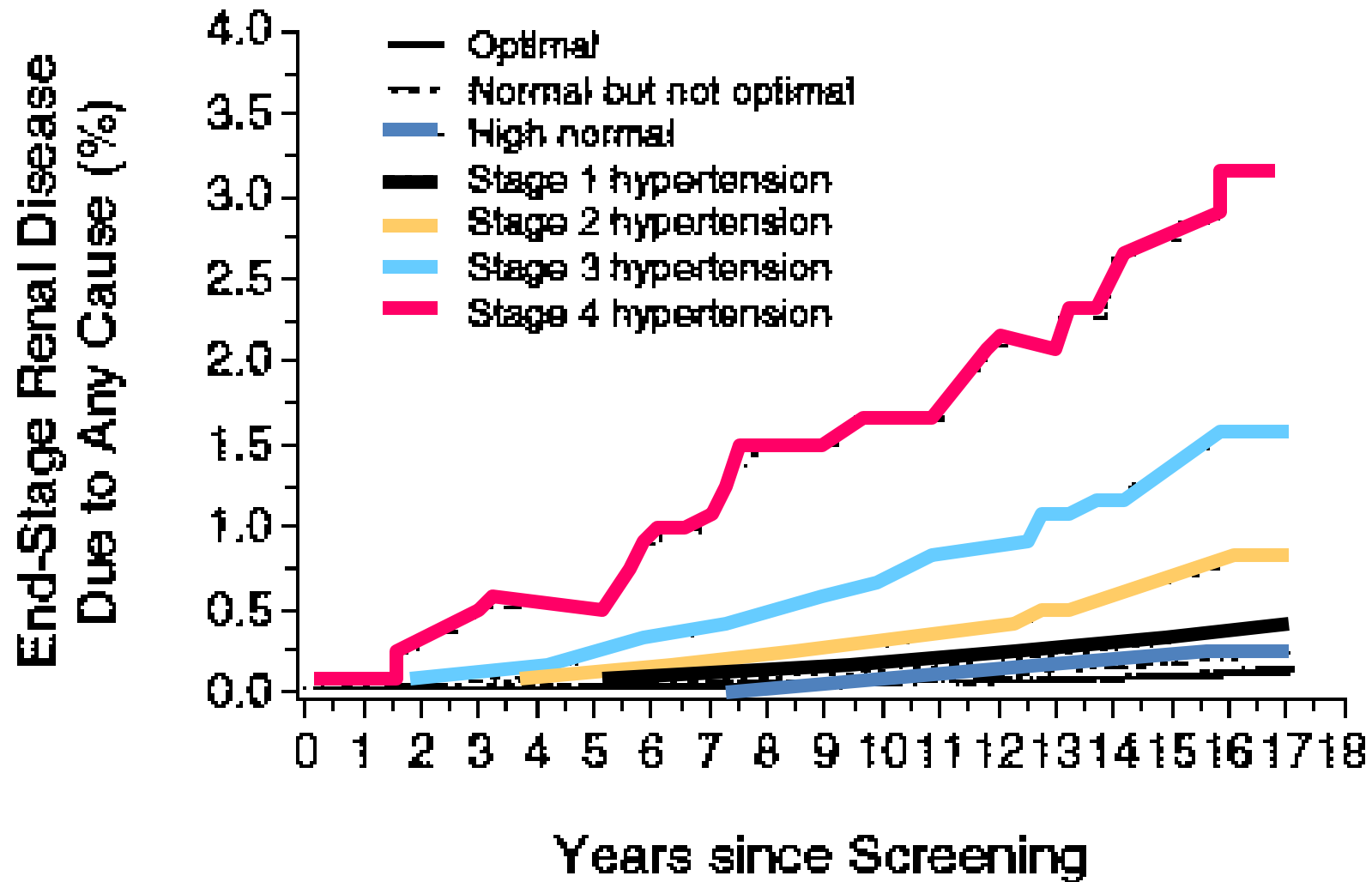
Multiple Risk Factor Intervention Trial (MRFIT)

Number Screened	361,659 men
Mean Follow-up	15.3 years
Overall incidence of ESRD	17.12/100,000

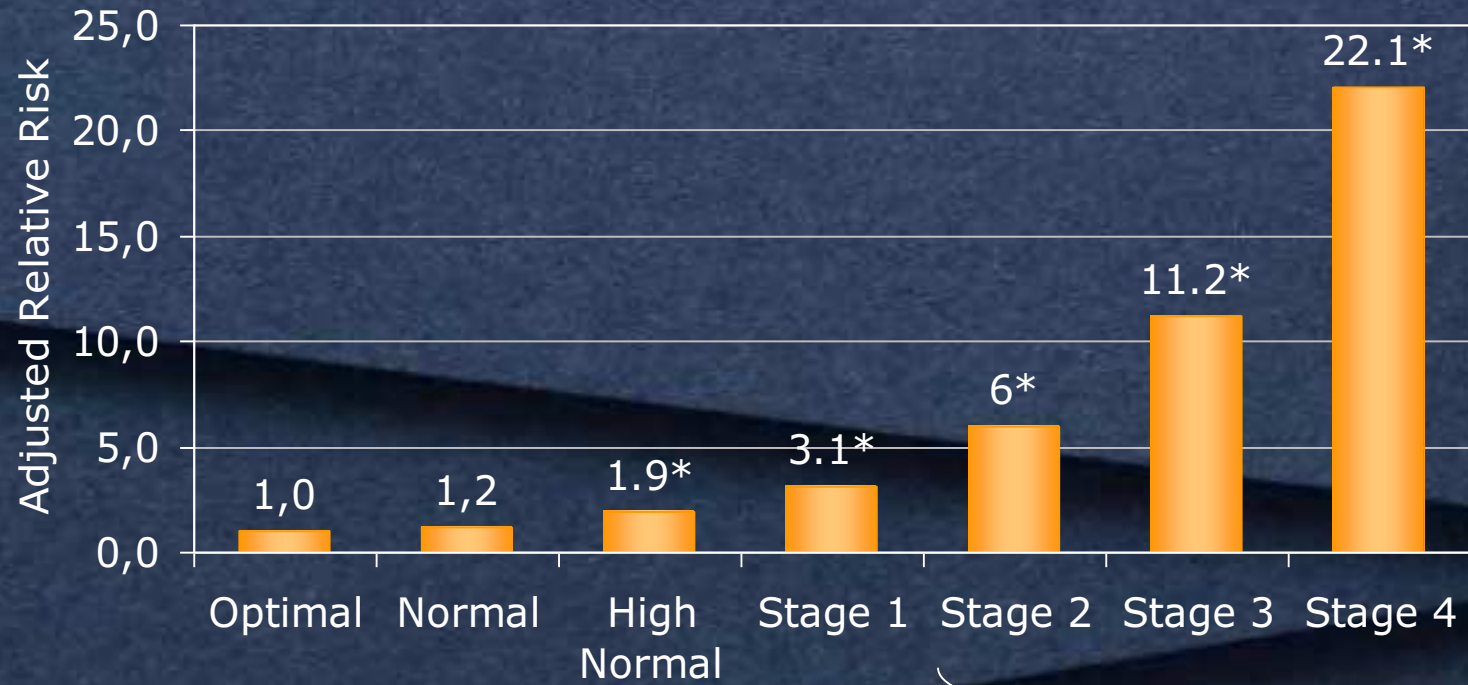
Result: There was a graded increase in the risk of developing ESRD with higher levels of blood pressure

Source: Klag MJ, et al. **Circulation.** 1994;89:941.

HIGH BLOOD PRESSURE SEVERITY AND ESRD INCIDENCE: MRFIT



ESRD Due to Any Cause In 332,544 Men Screened for MRFIT Adjusted Relative Risk[§]



* $p < 0.001$

Blood Pressure Category

Hypertension

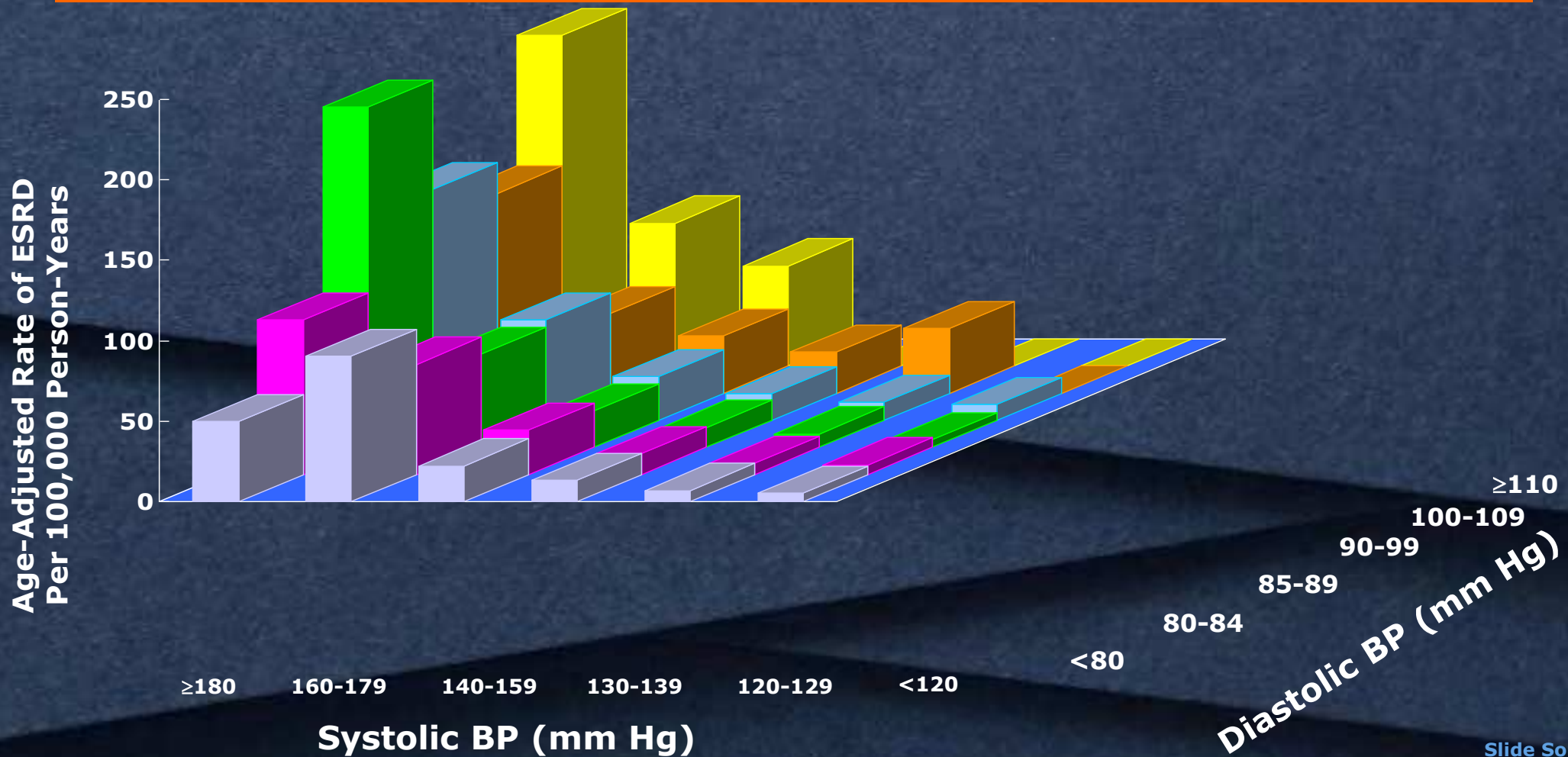
§ Men with optimal blood pressure was the reference category.

Klag MJ, et al. *N Engl J Med.* 1996;334(1):13-18.

www.hypertensiononline.org

Slide Source
HypertensionOnline
www.hypertensiononline.org

HTN Linked To Chronic Renal Disease Among 332,544 Men Screened for MRFIT

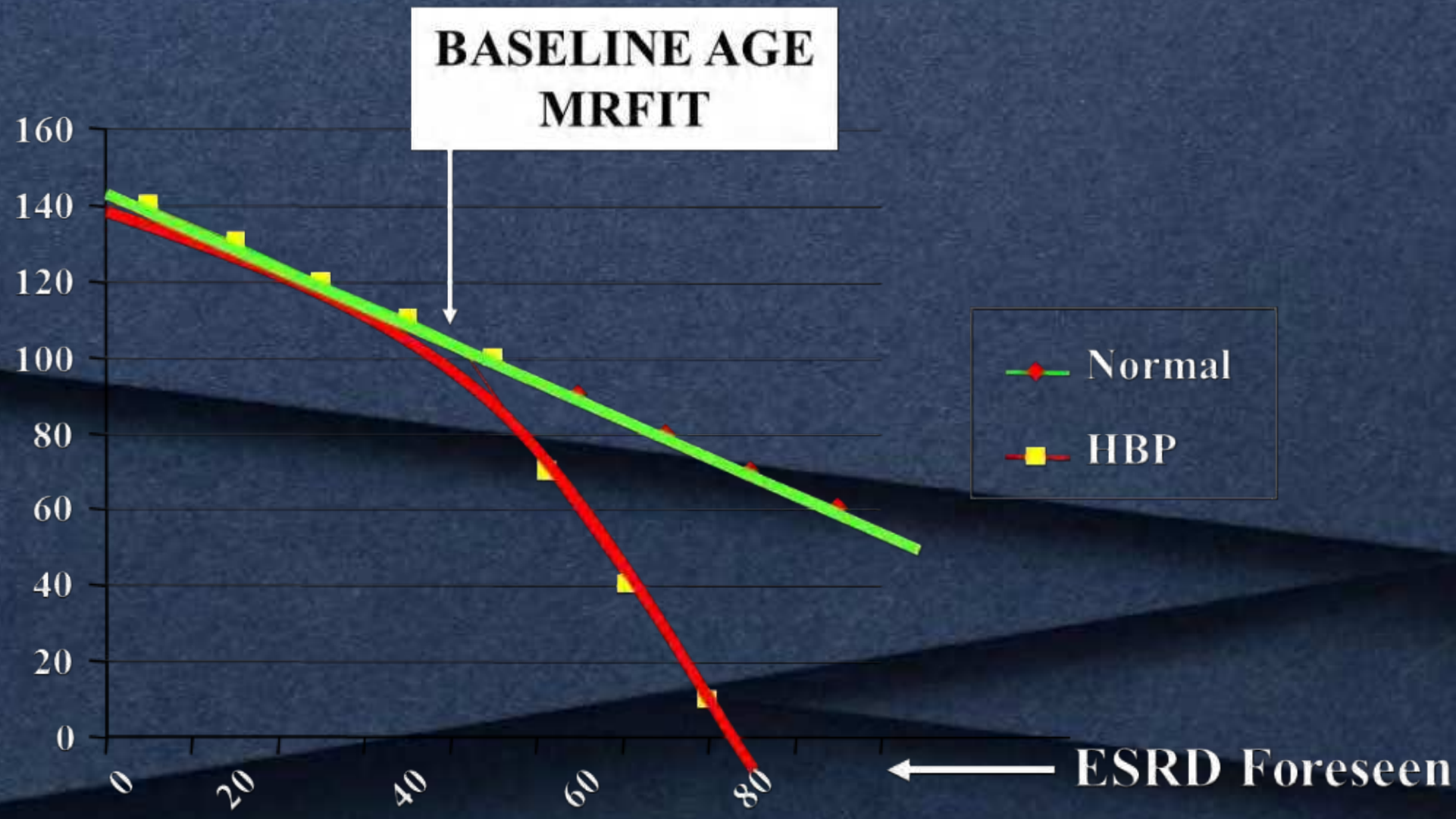


Adapted from Klag MJ, et al. *N Engl J Med.* 1996;334(1):13-18.

© Massachusetts Medical Society

Slide Source
HypertensionOnline
www.hypertensiononline.org

www.hypertensiononline.org



Prevalence & odds of CKD in NHANES 1999–2006 participants, by method used to estimate GFR, CKD stage, age, gender, race, & severity of disease (%)

NHANES 1999–2006 participants age 20 & older. *Estimate not reliable.

	eGFR MDRD					eGFR CKD-EPI					eGFR cystatin C				
	Stg 1	Stg 2	Stg 3	Stgs 4-5	OR	Stg 1	Stg 2	Stg 3	Stgs 4-5	OR	Stg 1	Stg 2	Stg 3	Stgs 4-5	OR
20-39	3.6	1.8	0.5	0.1*	ref	4.7	0.7	0.2*	0.1*	ref	5.5	1.3*	0.8*	0.2*	ref
40-59	3.3	3.9	4.2	0.2	1.6	4.9	2.5	2.0	0.2	1.4	3.2	3.6	3.3	0.3*	1.1
60+	2.3	8.4	26.3	1.8	5.9	2.4	8.6	24.3	2.1	5.8	2.8	8.8	21.4	2.0	3.6
Male	2.7	4.1	6.0	0.5	ref	3.5	3.4	5.2	0.6	ref	2.9	3.7	5.5	0.8	ref
Female	3.7	4.1	9.4	0.5	1.4	5.0	3.0	7.4	0.6	1.3	5.0	4.0	7.2	0.5	1.4
Non-Hispanic white	2.2	4.1	9.2	0.5	ref	3.2	3.3	7.4	0.6	ref	3.0	4.0	7.5	0.6	ref
Non-Hispanic Af Am	5.7	4.2	4.8	1.1	1.1	6.3	3.4	4.9	1.2	1.3	8.6	4.1	4.1	1.5	1.3
Other	6.2	3.9	3.3	0.5*	1.2	7.5	2.6	2.6	0.4	1.3	5.1	3.1	3.0	0.4*	1.0
Self-reported diabetes	8.9	12.8	19.4	2.7	2.5	11.8	10.2	17.0	3.1	2.5	7.6	11.4	15.0	2.9	1.9
Self-reported hypertension	4.1	7.0	16.7	1.6	1.8	5.4	5.9	14.6	1.7	1.8	3.6	8.2	14.9	2.1	2.0
Self-reported CVD	2.8	8.6	27.9	3.8	2.0	3.3	8.7	25.9	4.3	2.1	1.9*	10.2	25.8	4.2	2.3
Current smoker	4.4	3.7	3.6	0.5	1.1	5.9	2.3	2.4	0.5	1.1	6.2	4.8	4.3	0.6*	1.8
Obese (BMI ≥30)	3.9	5.6	8.0	0.6	1.1	5.5	4.2	6.6	0.6	1.1	3.7	6.1	8.0	0.6	1.2
All	3.2	4.1	7.8	0.5		4.3	3.2	6.3	0.6		4.0	3.9	6.4	0.6	

Is APOL1 genotype associated with a higher risk of kidney failure?

Methods and cohort

Retrospective

Observational study


AASK & CRIC cohorts
n = 4855

Outcomes


Kidney failure risk

Exposures


Self-identified race
(Black/ non-Black)


Presence of high-risk APOL1 genotype

Results



High-risk APOL1 genotype and risk of kidney failure

1.87

1.23 - 2.84

Minimal proteinuria subgroup

1.22

0.93 - 1.61

High proteinuria subgroup

2.04

1.10 - 3.77

Never developed proteinuria subgroup



Black vs non-Black



Low risk genotype

0.96


0.85 - 1.10

AASK, African American Study of Kidney Disease and Hypertension; CRIC, Chronic Renal Insufficiency Cohort; APOL1, Apolipoprotein L1

Conclusion: A high-risk APOL1 genotype is significantly associated with increased kidney failure risk. Screening patients without proteinuria for APOL1 could help providers better identify patients at risk for kidney failure.

Reference: Nguyen A, Suen S, Lin E. APOL1 genotype, proteinuria, and the risk of kidney failure: a secondary analysis of the AASK and CRIC studies. *Kidney Medicine*, 2022.

Visual Abstract by Denisse Arellano, MD

 @deniise_am

RISK OF CHRONIC KIDNEY DISEASE (CKD) DEVELOPMENT ACCORDING BASELINE SERUM CREATININE DISTRIBUTION.

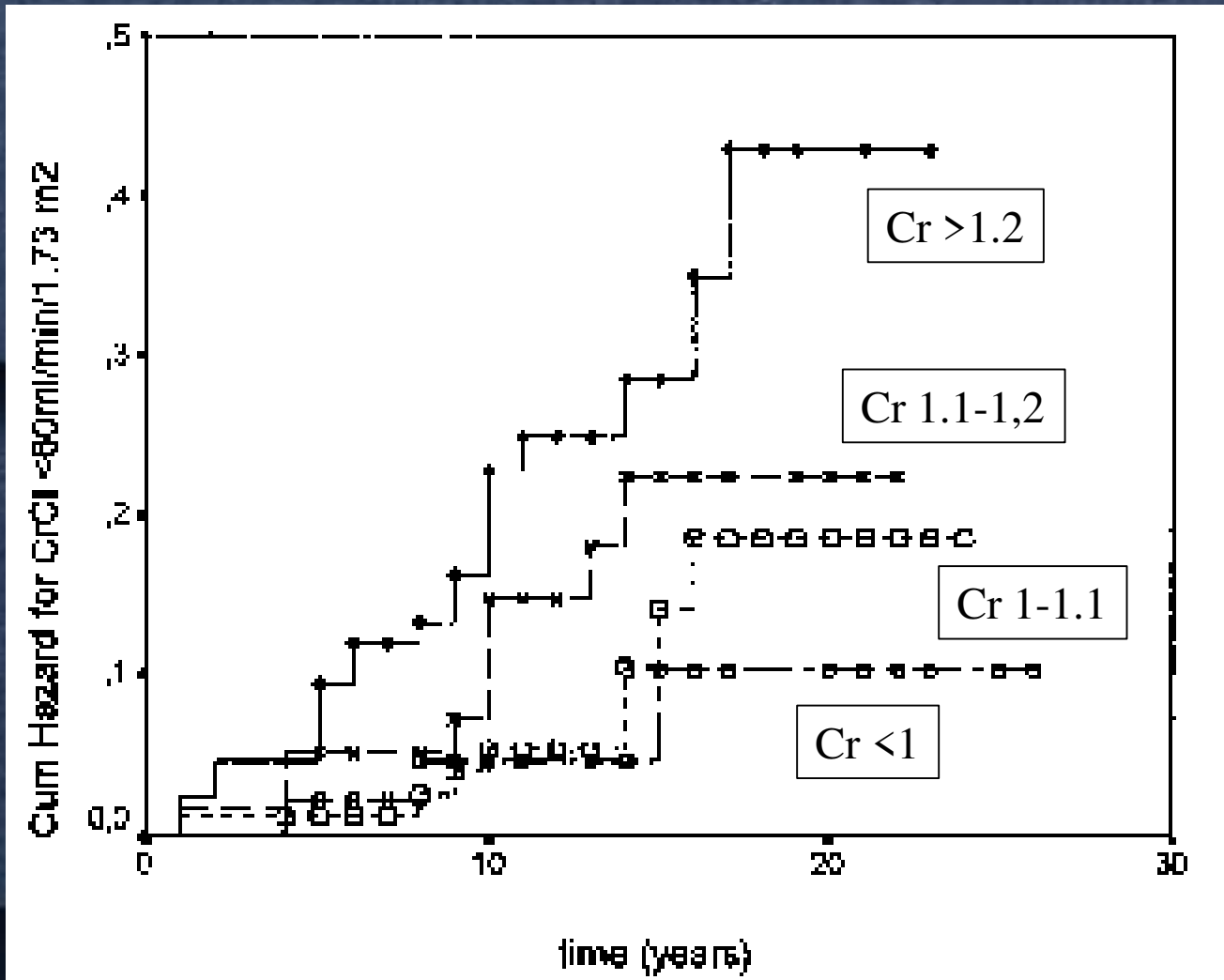


Figure 1. Risk of chronic kidney disease (CKD) development according baseline serum creatinine distribution. 1st quartile (\square); SCr: <math>< 1 \text{ mg/dl}</math> for male, <math>< 0.7 \text{ mg/dl}</math> for female. 2nd quartile (\circ); SCr: 1.0 to 1.1 mg/dl for male, 0.7 to 0.9 mg/dl for female. 3rd quartile (\times); SCr: 1.1 to 1.2 mg/dl for male, 0.9 to 1.0 mg/dl for female. 4th quartile (\bullet); SCr: >1.2 mg/dl for male, >1.0 mg/dl for female.

TAKE HOME MESSAGES



- Hypertension is very frequent in CKD, either as cause or consequence.
- Uncontrolled hypertension worsens CKD progression.
- Albuminuria is the better surrogate for renal disease.
- BP control is needed to prevent from ESRD.

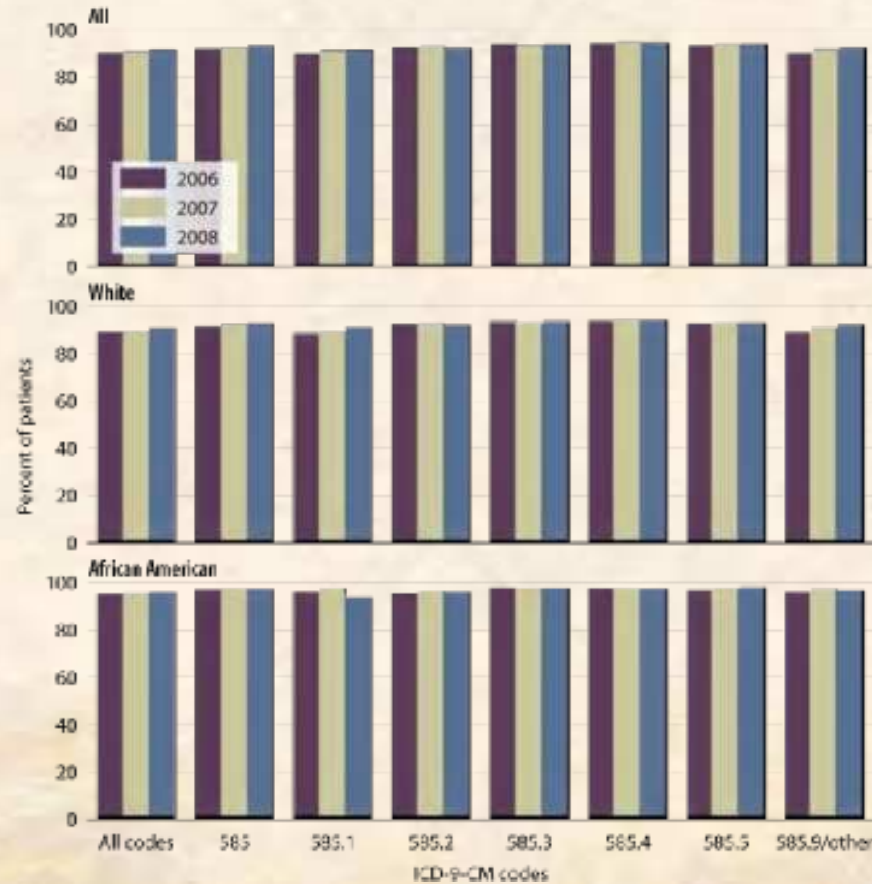


A wide-angle photograph of a bridge spanning a body of water during a vibrant sunset. The sky is filled with large, dark clouds illuminated from below by the setting sun, creating a warm orange and yellow glow. The bridge features a central pylon with multiple stay cables and several large arches supported by concrete piers. The water in the foreground is dark with some ripples. The text "THANKS A LOT!" is centered in the upper half of the image in a bold, blue, sans-serif font.

THANKS A LOT !

Prevalence of hypertension, by diagnosis code, race, & year

Table 2.19 (Volume 1)



ICD-9-CM codes

- 585.1 Chronic kidney disease, Stage 1
- 585.2 Chronic kidney disease, Stage 2 (mild)
- 585.3 Chronic kidney disease, Stage 3 (moderate)
- 585.4 Chronic kidney disease, Stage 4 (severe)
- 585.5 Chronic kidney disease, Stage 5 (excludes 585.4; Stage 5, requiring chronic dialysis.)
- 585.9/other Chronic kidney disease, unspecified

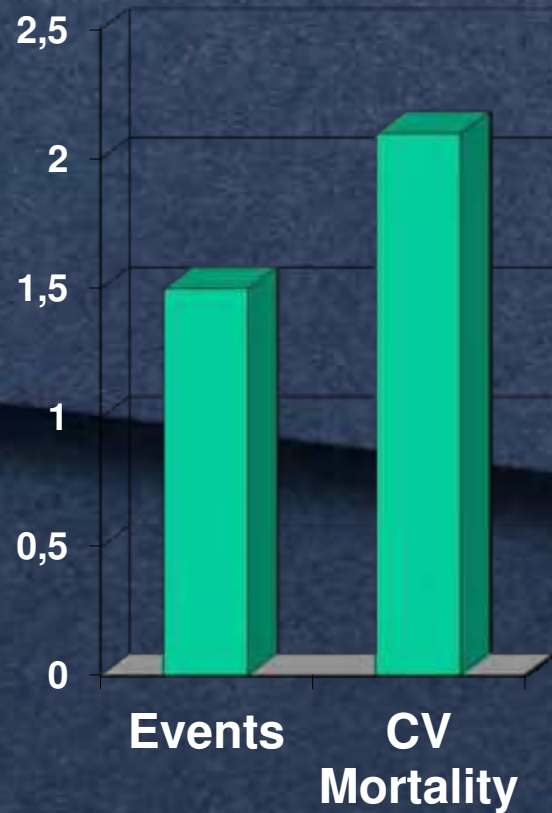
In USRDS analyses, patients with ICD-9-CM code 585.9 are considered to have code 585.5. See Appendix A for details.

CKD stage estimates are based on single measurements. For clinical care decisions, additional data should be present 3-6 months.

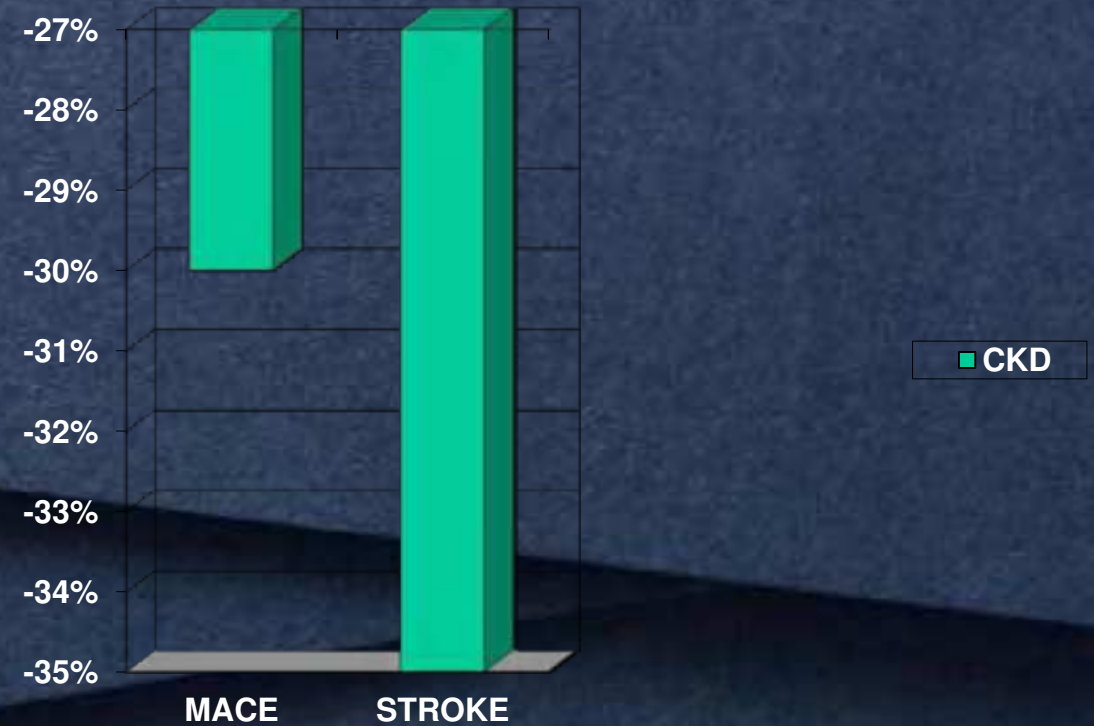
Medicare patients age 65 & older, surviving all of 2008; ESRD patients excluded.

PROGRESS Trial

CV RISK ASSOCIATED TO CKD

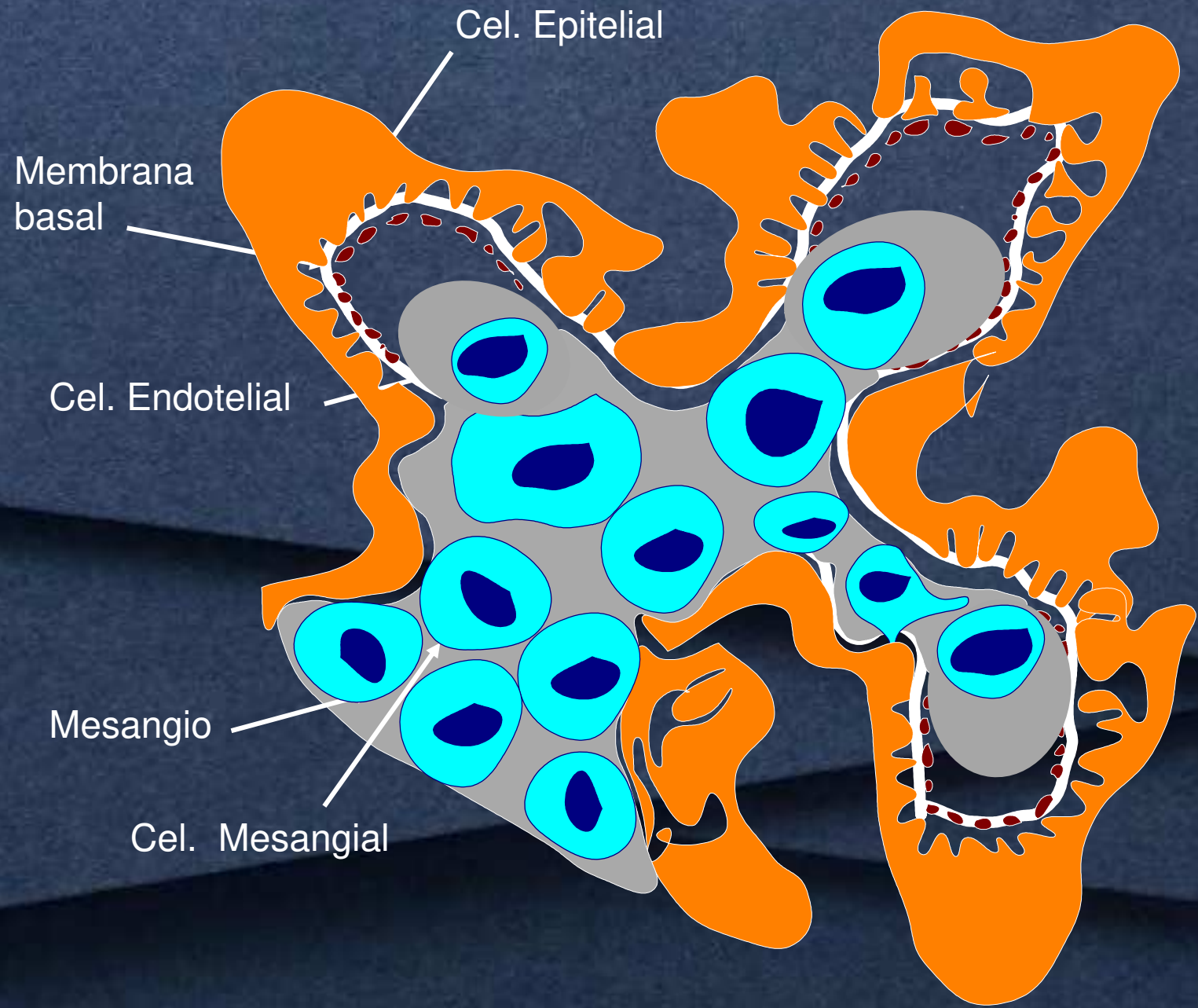


CV RISK REDUCTION FOR CKD PATIENTS

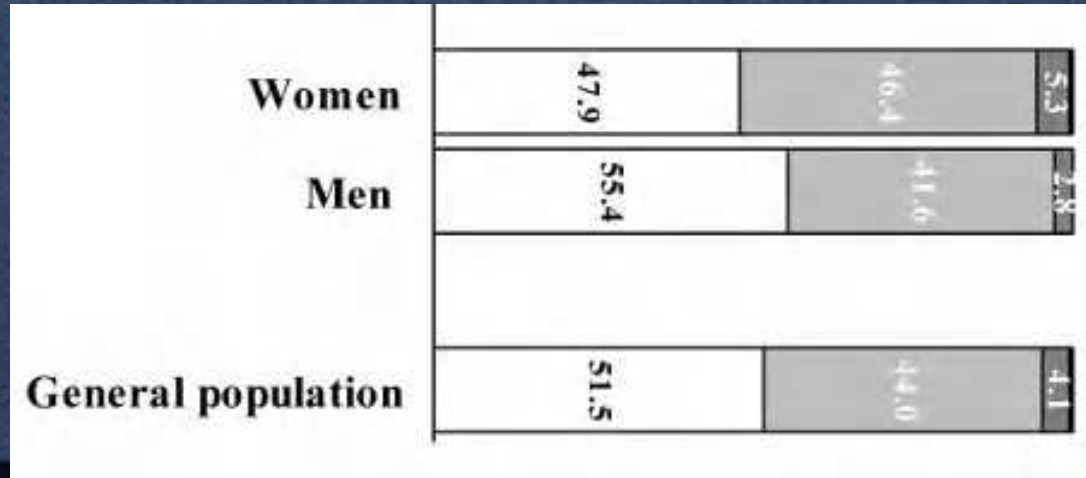


CKD: 1757 pacientes.
Non CKD: 4148 pacientes.

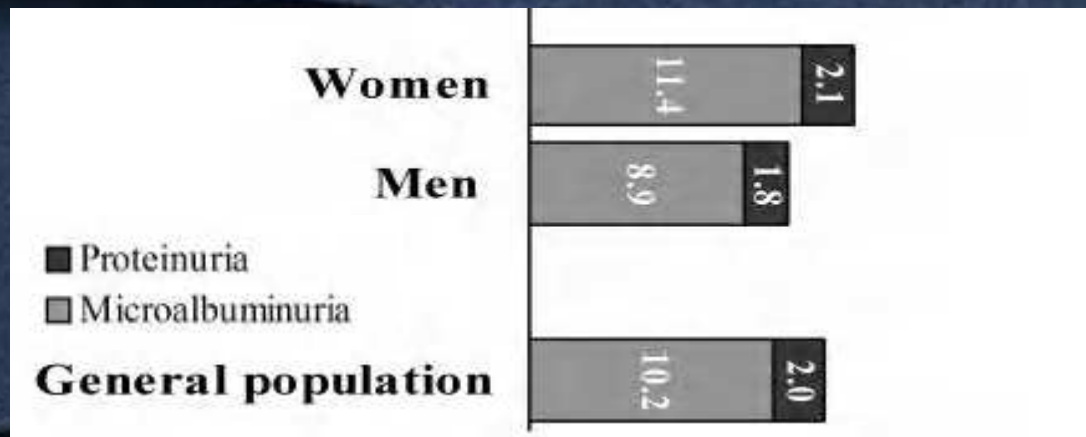
Minomiya T et al. *Kidney International* (2008) 73, 963–970



PREVALENCE OF C.K.D. IN TURKEY



Decreased GFR



Increased UAE

Postulated tubuloglomerular feedback (TGF) mechanisms in normal physiology, early stages of diabetic nephropathy, and after sodium-glucose cotransporter (SGLT) 2 inhibition.

