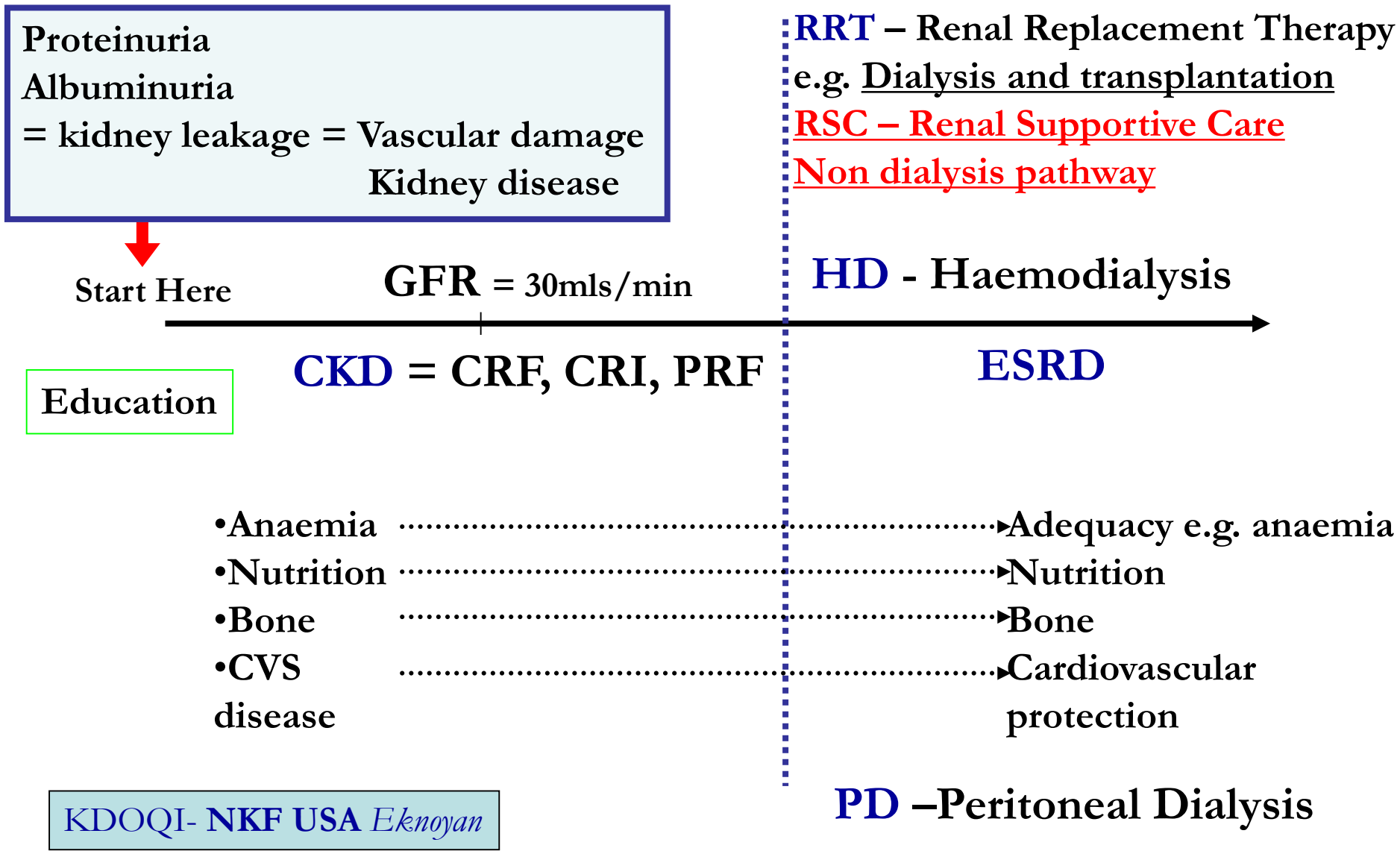
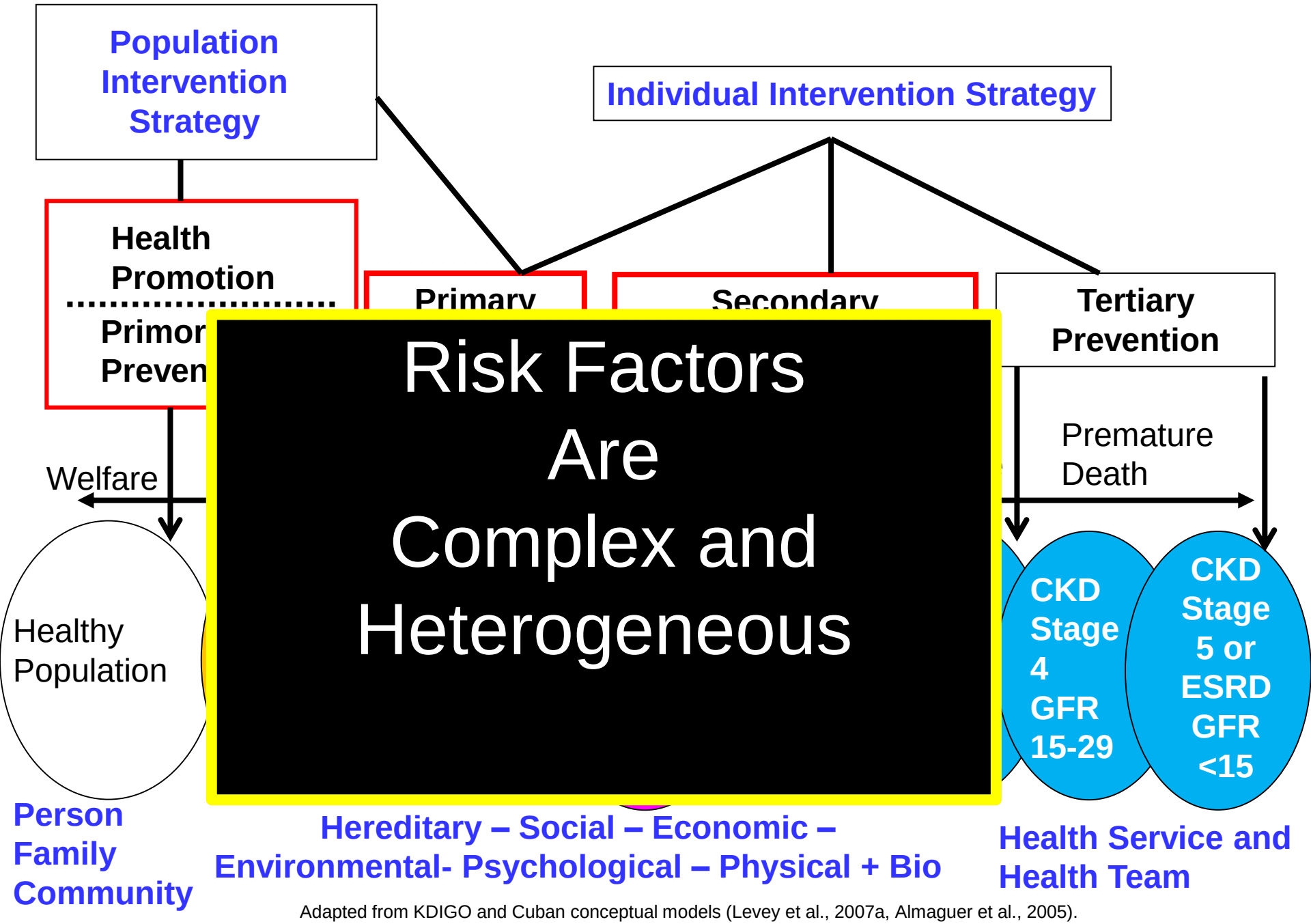
Interventions to delay progression of kidney disease and minimize risk of adverse events or complications

A/Prof Ivor Katz |Nephrologist

St George Hospital

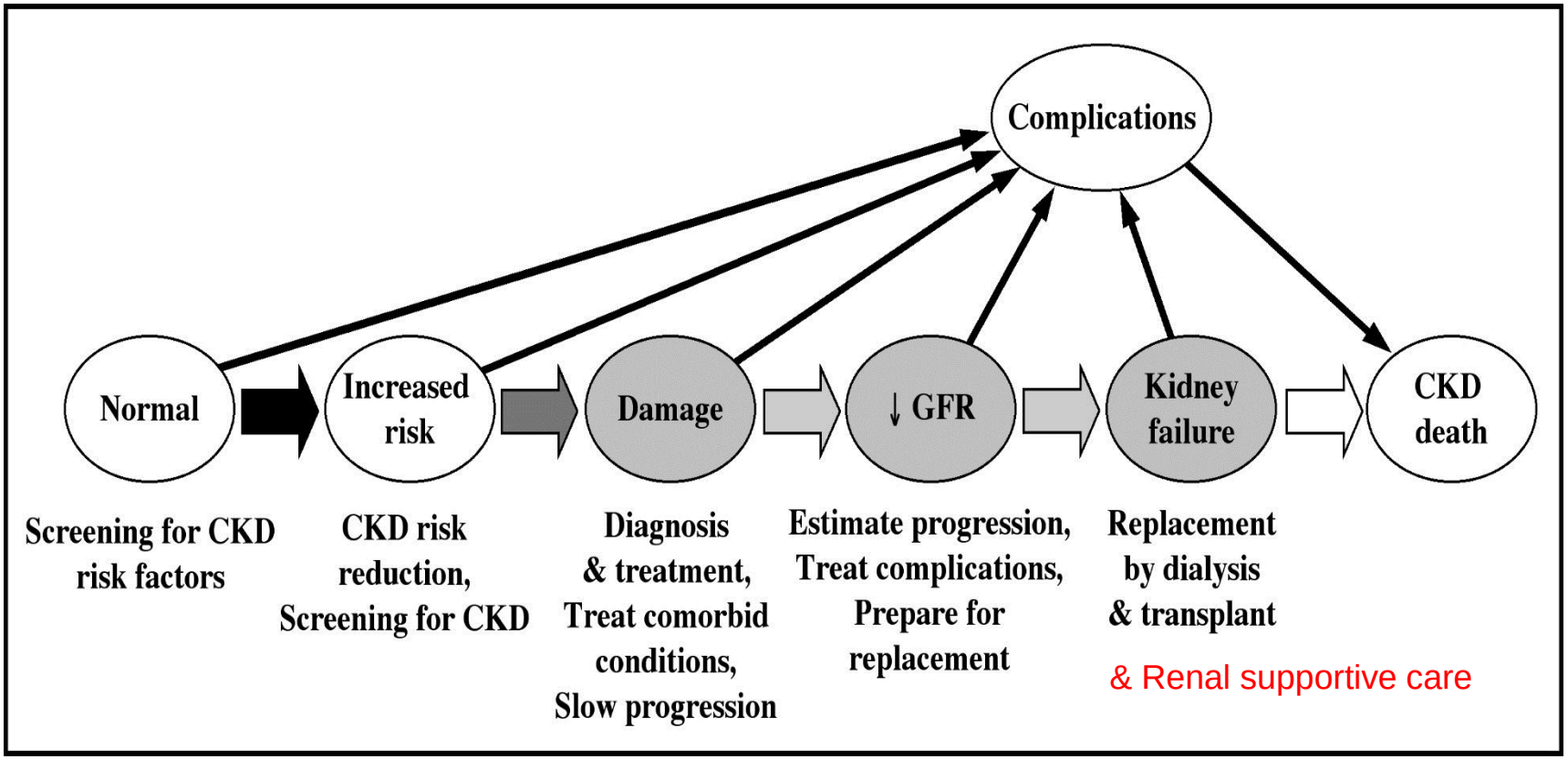
Understanding CKD 'Kidney Failure"





Adapted from KDIGO and Cuban conceptual models (Levey et al., 2007a, Almaguer et al., 2005).
CKD – chronic kidney disease, GFR – glomerular filtration rate ml/min; ESRD – End Stage Kidney Disease or CKD stage 5

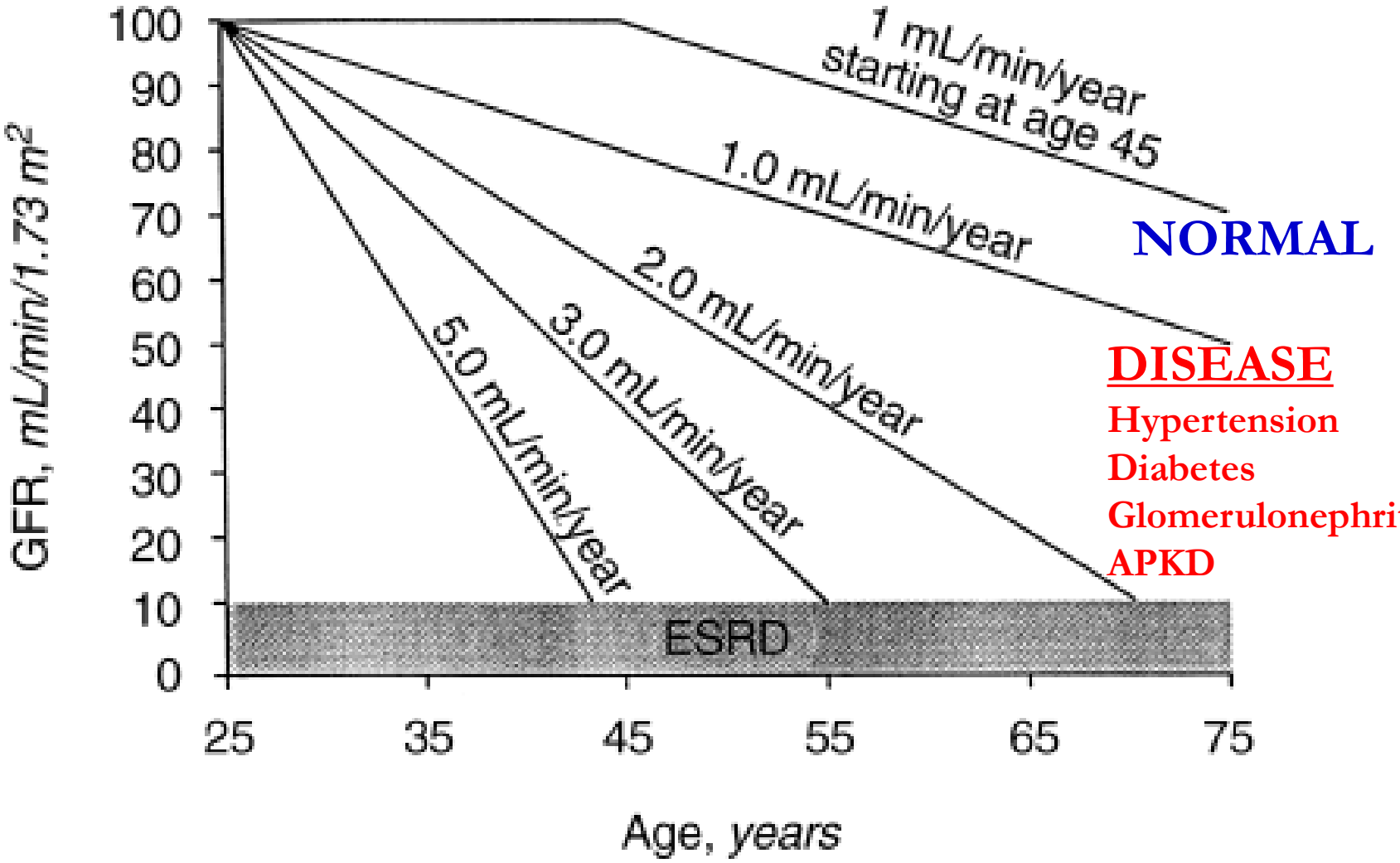
Conceptual Model of CKD Progression



Levey et al. AJKD
2009-03-01, Volume 53, Issue 3, Pages S4-S16)

Glomerular filtration rate (GFR) decline… the facts

Herbert et al *Kidney International* **59** (4) p1211



Progression, remission, regression of chronic renal diseases
Lancet 2001; 357: 1601–08

Review

Progression, remission, regression of chronic renal diseases

Piero Ruggenenti, Arrigo Schieppati, Giuseppe Remuzzi

The prevalence of chronic renal disease is increasing worldwide. Most chronic nephropathies lack a specific treatment and progress relentlessly to end-stage renal disease. However, research in animals and people has helped our understanding of the mechanisms of this progression and has indicated possible preventive methods. The notion of renoprotection is developing into a combined approach to renal diseases, the main measures being pharmacological control of blood pressure and reduction of proteinuria. Lowering of blood lipids, smoking cessation, and tight glucose control for diabetes also form part of the multimodal protocol for management of renal patients. With available treatments, dialysis can be postponed for many patients with chronic nephropathies, but the real goal has to be less dialysis—in other words remission of disease and regression of structural damage to the kidney. Experimental and clinical data lend support to the notion that less dialysis (and maybe none for some patients) is at least possible.

Modifying the Risk Factors

Definitions of progression, remission, and regression

Remuzzi NEJM 1998 339;20
1448-56

Variable	Progression	Remission	Regression
Proteinuria	1 g/24 h	<1 g/24 h	<0·3 g/24 h
Glomerular filtration rate	Declining*	Stable	Increasing
Renal structural changes	Worsening	Stable	Improving
*Faster than physiological decline associated with aging (1 mL/min/1·73 m^2 per month).			

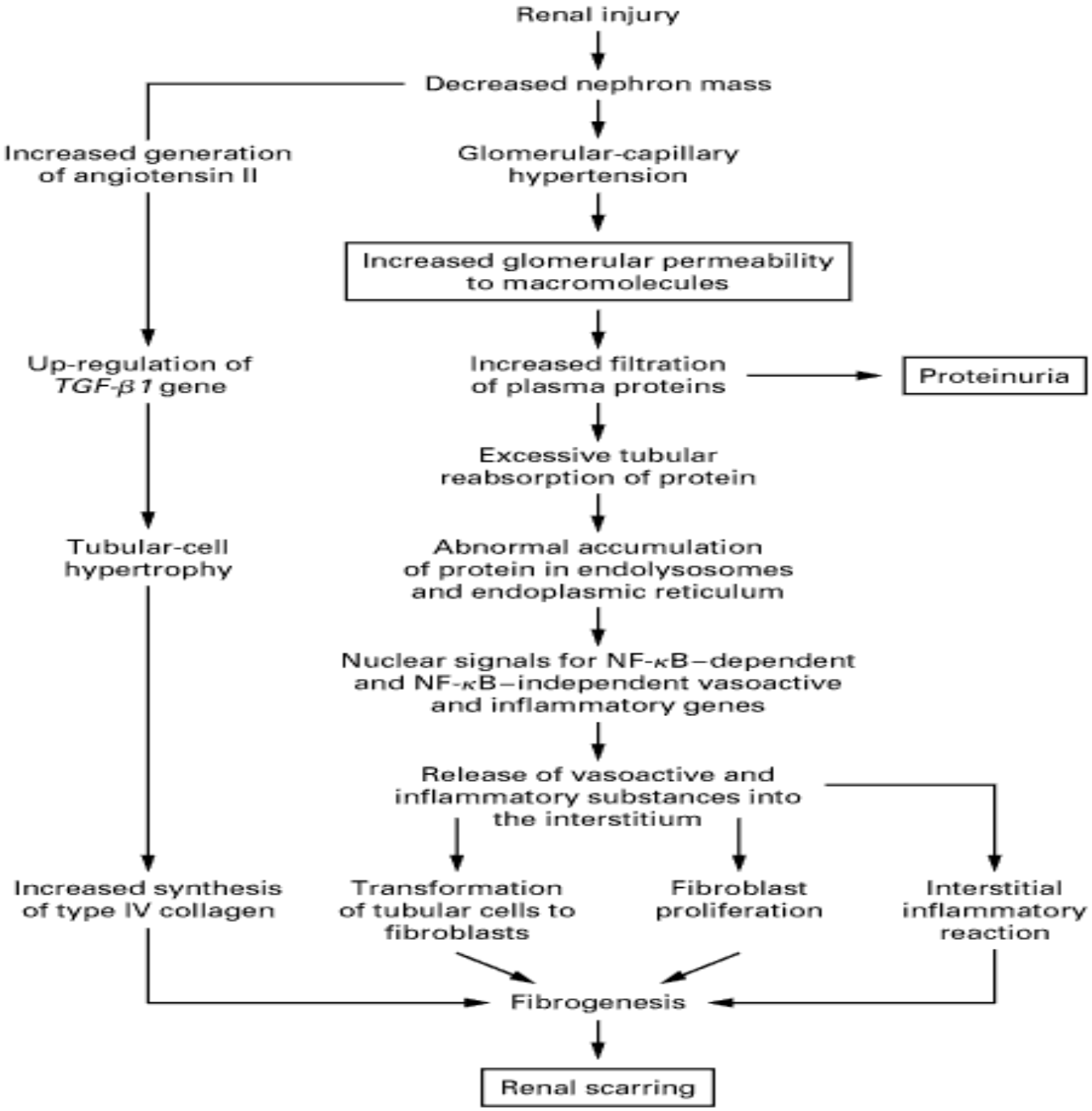
Targets of the multidrug approach to reduce decline in GFR

Lancet vol 357 p1601 Ruggenenti

Variable	Target
Systolic or diastolic blood pressure (mm Hg)	<125/75*
24 h urinary protein excretion rate (g)	<0·3
LDL cholesterol (mmol/L)	<2·6
LDL and VLDL cholesterol (mmol/L)	<3·4
Proportion HbA_{1C}†	<7·5%
*Morning, pretreatment value; †In diabetics.	

Progression, remission, regression of chronic renal diseases
Lancet 2001; 357: 1601–08

Effects of increased glomerular permeability to proteins on progressive renal injury

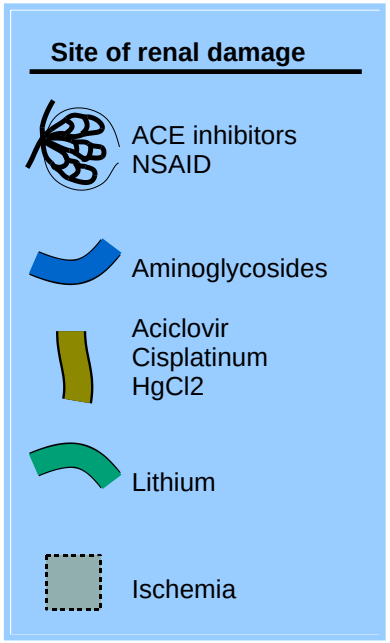


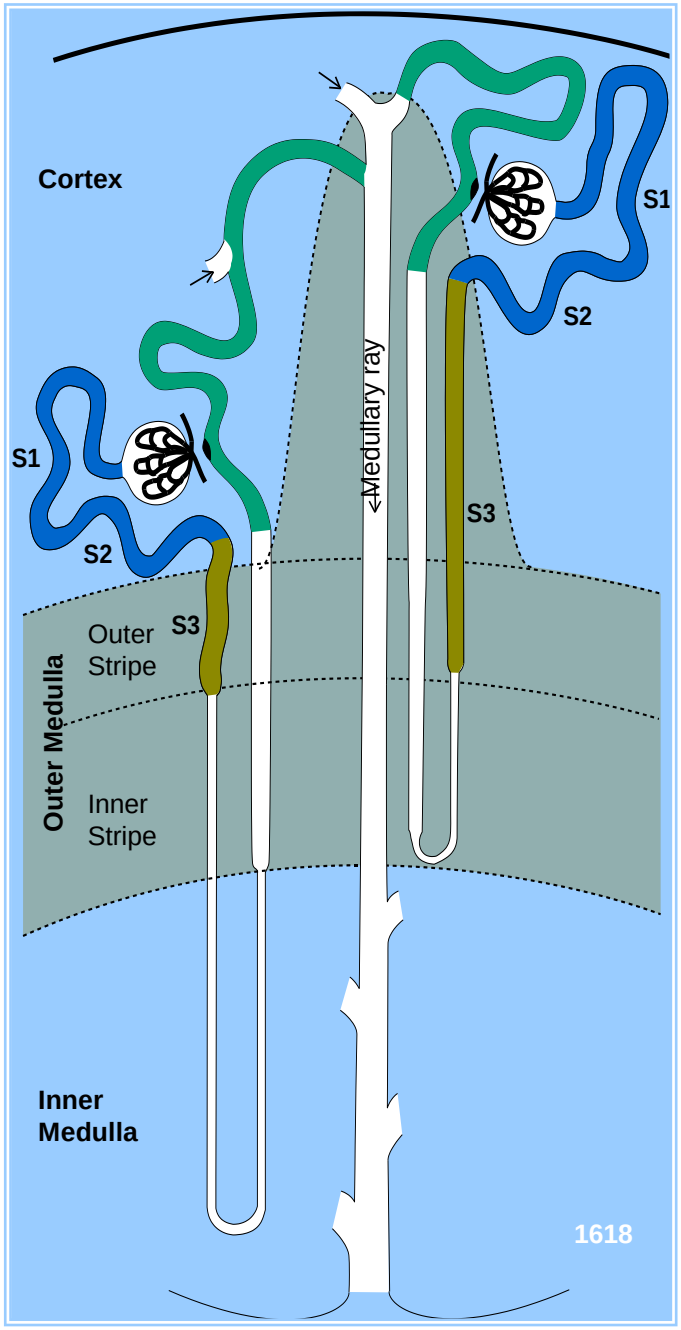
Remuzzi
NEJM
1998 339;20
1448-56

The nephron

Vulnerability of the kidney

- Important blood flow (1/4 of cardiac output)
- High metabolic activity
- Largest endothelial surface by weight
- Multiple enzyme systems
- Transcellular transport
- Concentration of substances
- Protein unbinding
- High O_2 consumption/delivery ratio in outer medulla

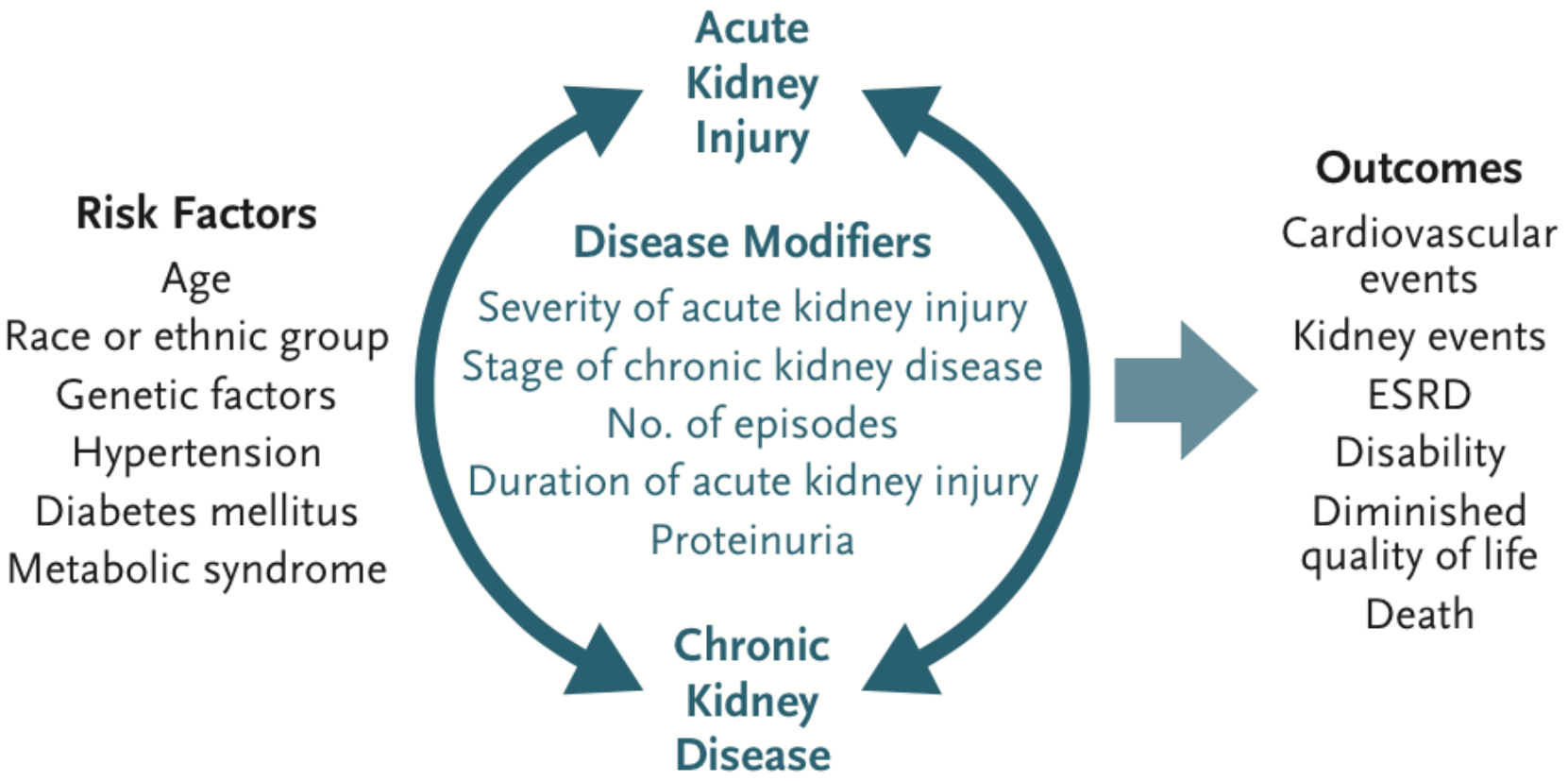




Acknowledgement to Mark de Broer

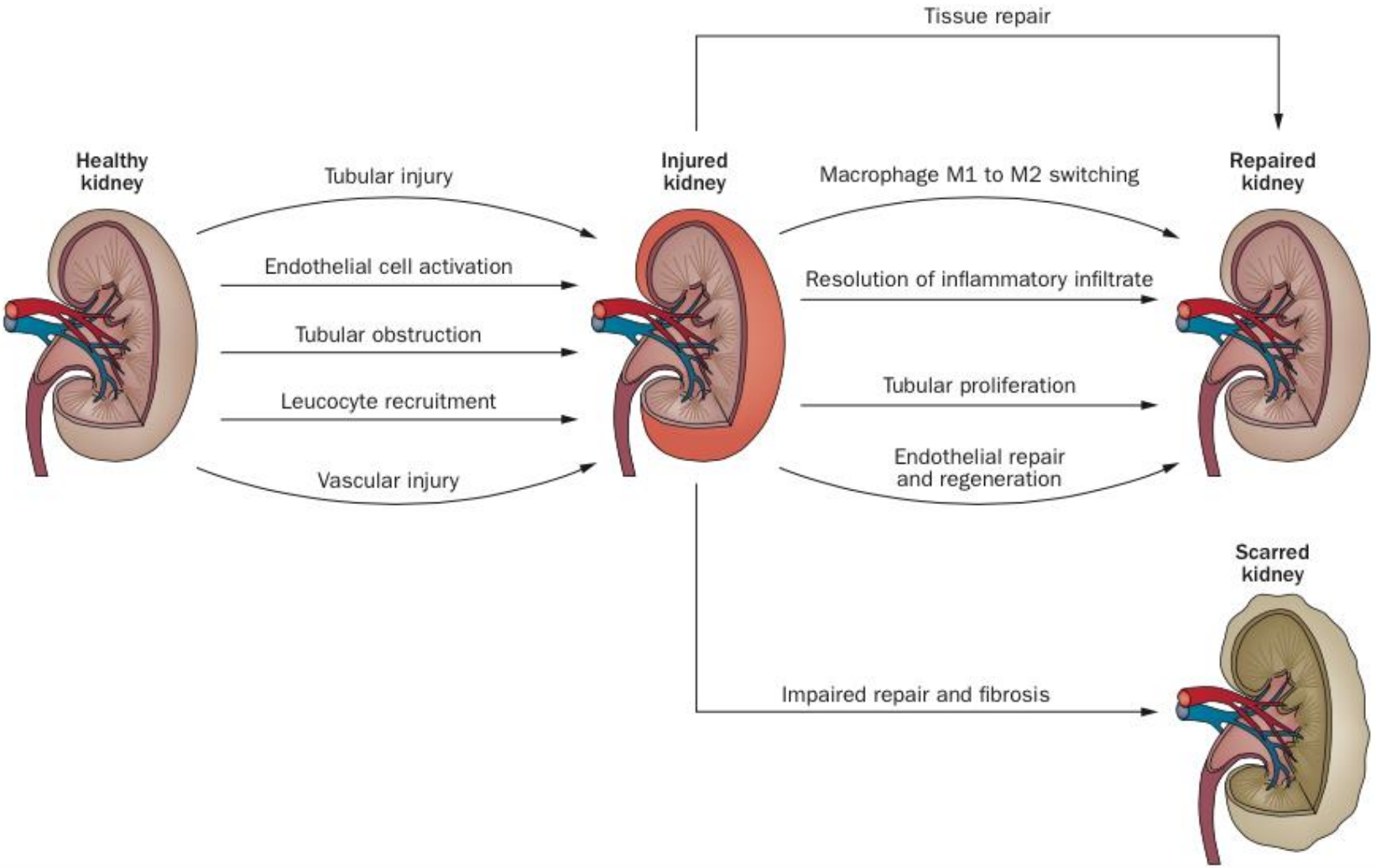
Kidney Health Australia

AKI and CKD as an Interconnected Syndrome



N Engl J Med 2014;371:58-66

Mechanisms of Kidney Injury and subsequent repair after AKI

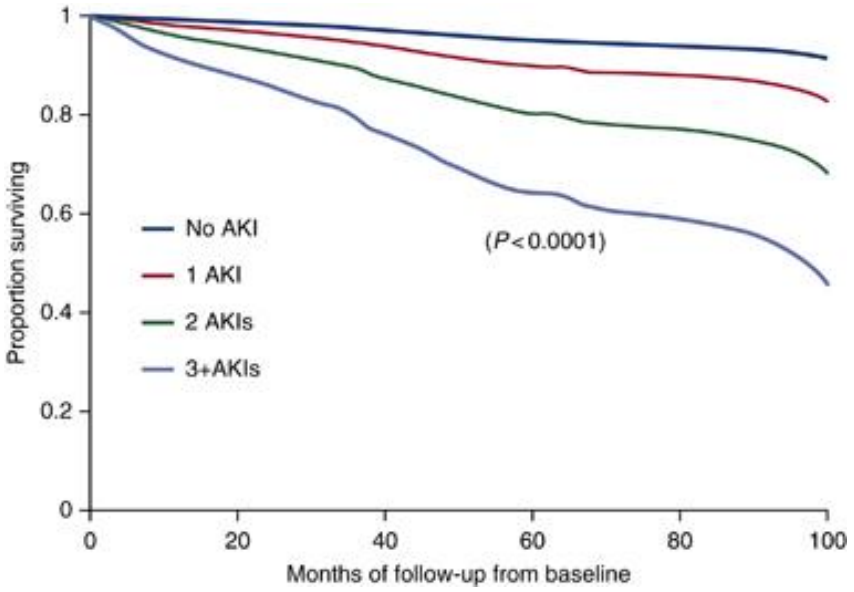


Reference

Kidney Health Australia

AKI progressing to ESKD

- Distinction between AKI and CKD may be artificial.
- The **integrated clinical syndrome** of diminished GFR, with acute & chronic stages.
- Patients should be provided long-term follow-up even with first episodes of AKI or even if they presented with normal renal function.

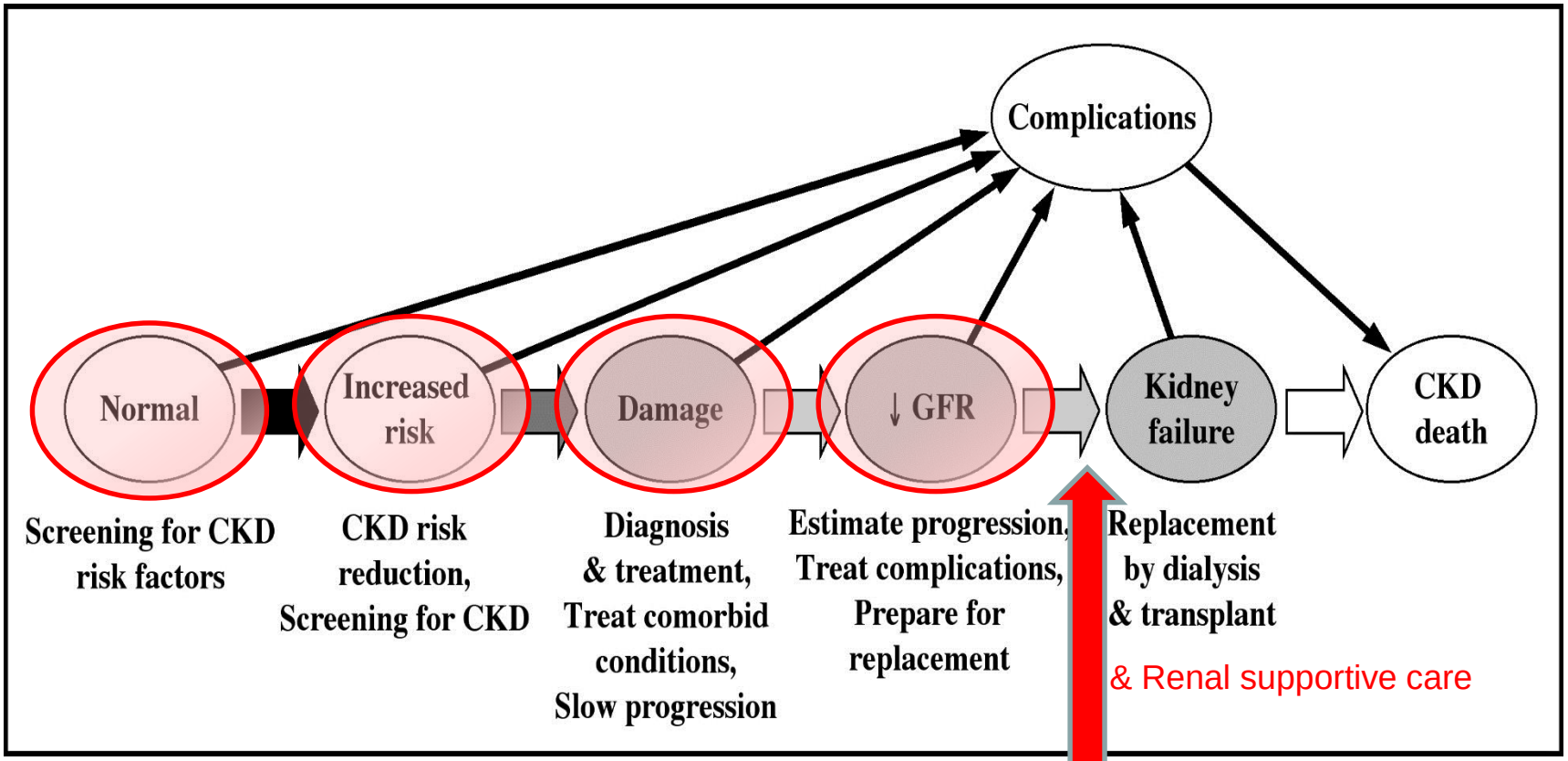


Effect of acute kidney injury (AKI) frequency on outcomes.

Thakar et al.DM pts with >2 episodes of AKI were much more likely to progress to stage 4 CKD than patients who experienced only one episode of AKI.

1. Chawla LS, Kimmel PL, Kidney Int. 2012 Sep;82(5):516-24 Acute kidney injury and chronic kidney disease: an integrated clinical syndrome.
2. Thakar CV, Christianson A, Himmelfarb J et al. Acute kidney injury episodes and chronic kidney disease risk in diabetes mellitus. Clin J Am Soc Nephrol 2011

Stages in the Progression of CKD and Therapeutic Strategies



Levey et al. AJKD
2009-03-01, Volume 53, Issue 3, Pages S4-S16)

STOP Here!

Nurse role in CKD

Reduce the impact of CKD

Screen for risks

- Using Kidney Health Check
- Diabetes
- Hypertension
- Cardiovascular using Absolute CVD Risk Calculator*
- Other CKD risk factors
- Using health checks & item numbers

Manage disease

- Using care plans and item numbers
- Promote self management
- Diabetes
- Hypertension
- CKD
- Symptoms

Monitor patient progress

- Using item numbers
- Adherence to treatment
- Nephrotoxic medications

*Refer to slide 20

Increased Risk - CKD Screening

CKD Screening Recommendations in Australia?

Mike G screening is done by checking:

- ✓ urine albumin/creatinine ratio (ACR)
- ✓ estimated glomerular filtration rate (eGFR)
- ✓ blood pressure

The Kidney Health Check

All 3 screening tests should be performed in high risk patients to maximise the likelihood of CKD detection as there is variable overlap of indicators of kidney damage.

- In AusDiab study, 92% of patients with eGFR < 60 mL/min/1.73 m^2 did not have albuminuria/proteinuria
- 57% of subjects with albuminuria/proteinuria did not have an eGFR < 60 mL/min/1.73 m^2

RACGP Guidelines for preventive activities in general practice 8th edition

Screening for CKD

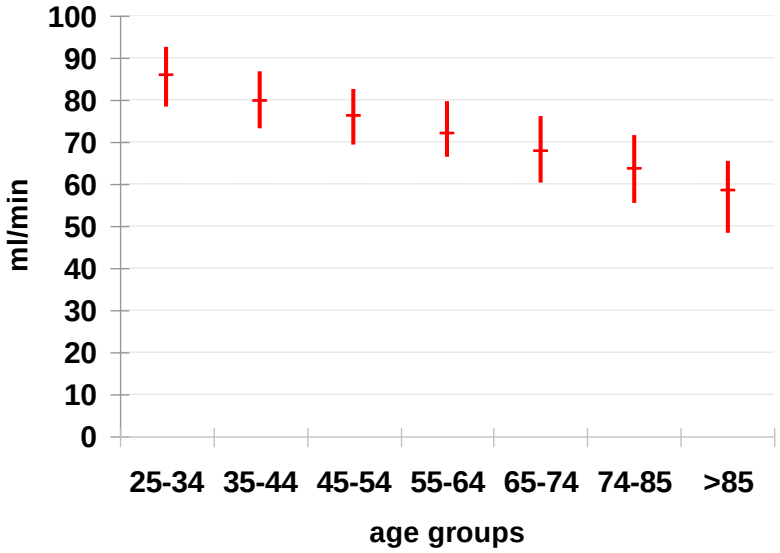
Indications for assessment*	Recommended assessments	Frequency
Diabetes	Urine ACR, eGFR, blood pressure If urine ACR positive repeat twice over 3 months (preferably first morning void) If eGFR < 60mL/min/1.73m^2 repeat within 7 days	Every 1-2 years†
Hypertension		
Established cardiovascular disease**		
Family history of kidney failure		
Obesity (BMI ≥30 kg/m^2)		
Smoker		
Aboriginal or Torres Strait Islander origin aged ≥ 30 years‡		
History of acute kidney injury	See recommendations in handbook	

*Whilst being aged 60 years of age or over is considered to be a risk factor for CKD, in the absence of other risk factors it is not necessary to routinely assess these individuals for kidney disease.
**Established cardiovascular disease is defined as a previous diagnosis of coronary heart disease, cerebrovascular disease or peripheral vascular disease.
† Annually for individuals with diabetes or hypertension.
‡ Refer to booklet for more details regarding recommendations for testing in Aboriginal and Torres Strait Islander peoples.

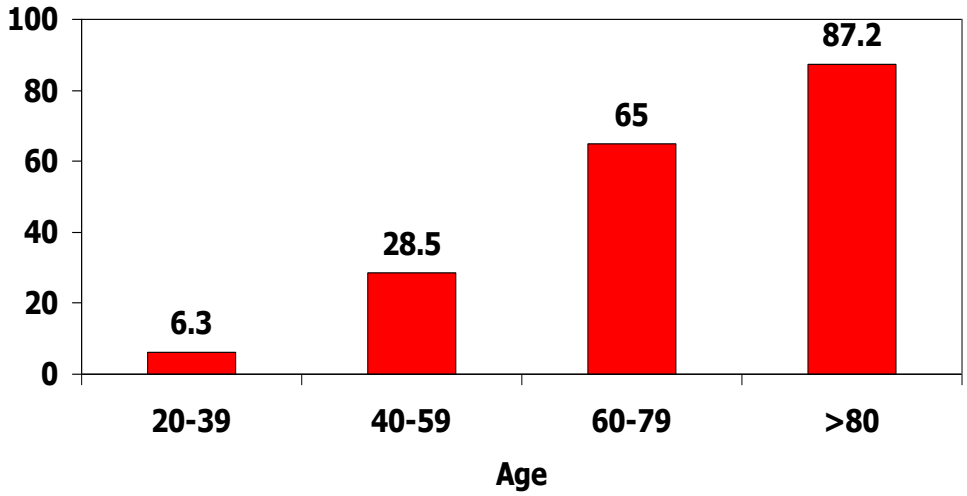
Chronic Kidney Disease (CKD) Management in General Practice, 3rd edition. Kidney Health Australia: Melbourne, 2015

GFR and ageing

Estimated GFR (MDRD)
Median and interquartile range



Prevalence of
eGFR < 60 mL/min in population



GFR declines by 5-8mL/min/1.73m^2 each decade

NOTE* Current Recommendations - PEAK

Whilst being aged 60 years of age or over is considered to be a risk factor for CKD, in the absence of other risk factors it is not necessary to routinely assess these individuals for kidney disease.

K. Sikaris; Unpublished Data

Guidelines for Referral And Goals of management

Kidney Health Australia GP guidelines

KIDNEY HEALTH AUSTRALIA

Stages of CKD

Kidney Function Stage	GFR (mL/min/1.73m²)	Albuminuria Stage: Normal (urine ACR mg/mmol) Male: < 2.5 Female: < 3.5	Microalbuminuria (urine ACR mg/mmol) Male: 2.5-25 Female: 3.5-35	Macroalbuminuria (urine ACR mg/mmol) Male: > 25 Female: > 35
1	≥90	Not CKD unless haematuria, structural or pathological abnormalities present		
2	60-89			
3a	45-59			
3b	30-44			
4	15-29			
5	<15 or on dialysis			

Goals of management

Investigations to exclude treatable kidney disease Reduce progression of kidney disease Assessment of absolute cardiovascular risk Avoidance of nephrotoxic medications or volume depletion	Investigations to exclude treatable kidney disease Reduce progression of kidney disease Reduce cardiovascular risk Avoidance of nephrotoxic medications or volume depletion	Investigations to exclude treatable kidney disease Reduce progression of kidney disease Reduce cardiovascular risk Avoidance of nephrotoxic medications or volume depletion
	Early detection and management of complications Adjustment of medication doses to levels appropriate for kidney function Appropriate referral to a Nephrologist when indicated	Early detection and management of complications Adjustment of medication doses to levels appropriate for kidney function Appropriate referral to a Nephrologist when indicated
		Prepare for dialysis or pre-emptive transplant if eGFR <30 mL/min/1.73m² Discuss advanced care directive if dialysis inappropriate Multidisciplinary team involvement

Kidney Health Australia
https://kidney.org.au/cms_uploads/docs/ckd-management-in-gp-handbook-3rd-edition.pdf

Ht 179cm
Wt 98kg

BMI
30.58kg/m^2

Case study – Mike G

Mike's results:

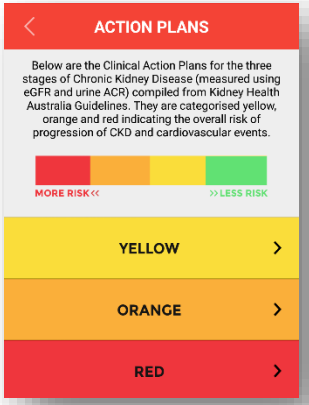
Test	Results 4 months ago	Results
Blood pressure		155/90 mmHg (seated)
Serum Creatinine		100 μmol/L
eGFR		74 mL/min/1.73m^2
HbA1c		8.4% / 68 mmol/mol
Total cholesterol		6.1 mmol/L
Urine ACR	4.6 mg/mmol (random spot)	10 mg/mmol (first void)
Urate		0.55 mmol/L

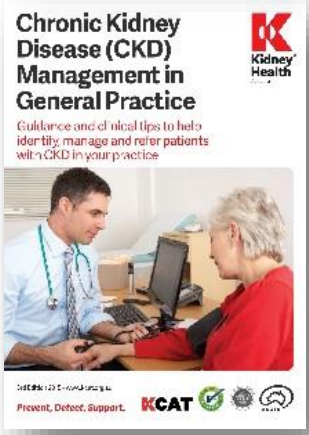
Staging CKD

Combine eGFR stage, albuminuria stage and underlying diagnosis to specify CKD stage e.g. stage 3b CKD with microalbuminuria secondary to diabetic kidney disease

		Albuminuria Stage		
GFR Stage	GFR mL/min/1.73m²	**Normal** urine ACR mg/mmol Male: < 2.5 Female: < 3.5	**Microalbuminuria** urine ACR mg/mmol Male: 2.5-25 Female: 3.5-35	**Macroalbuminuria** urine ACR mg/mmol Male: > 25 Female: > 35
1	≥90	*Not CKD unless haematuria, structural or pathological abnormalities present*		
2	60-89		X	
3a	45-59			
3b	30-44			
4	15-29			
5	<15 or on dialysis			

Colour-coded Clinical Action Plans in handbook and on CKD-Go! App





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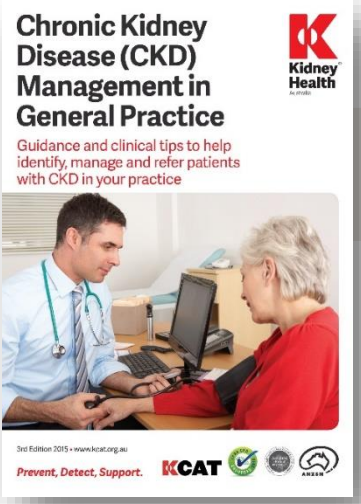
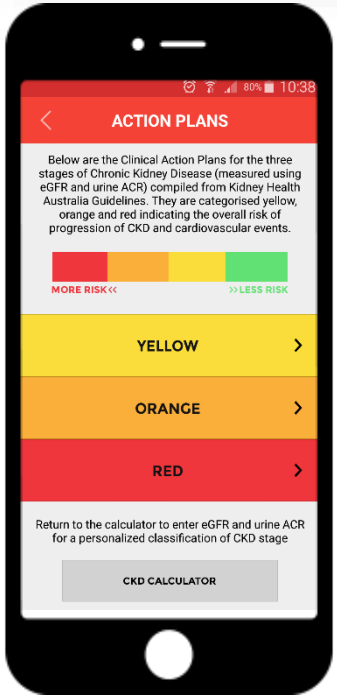




Yellow Clinical Action Plan

Stage 2 CKD with microalbuminuria, probably secondary to diabetic kidney disease

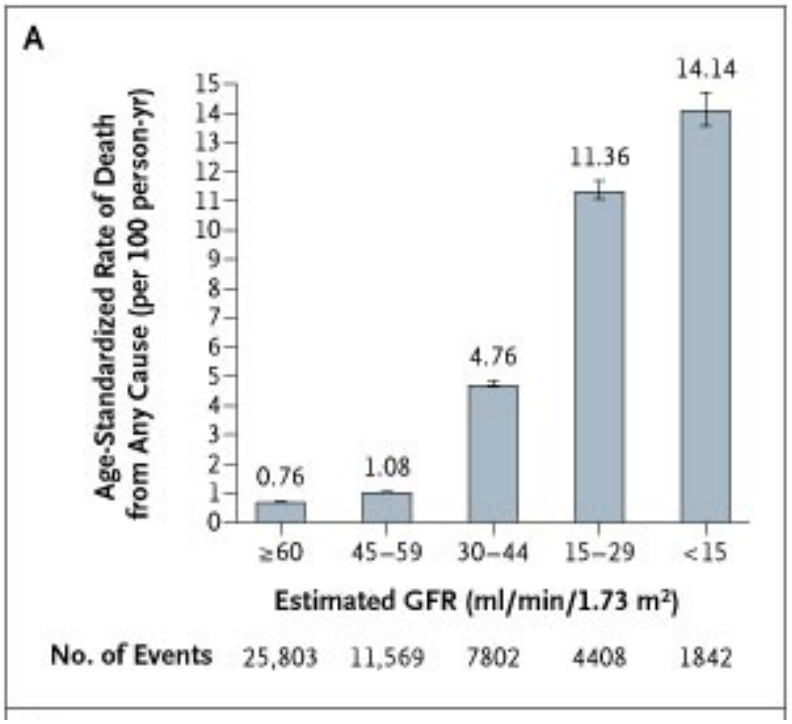
Goals of management

- Investigations to exclude treatable disease
- Assessment of absolute cardiovascular risk
- Reduce cardiovascular risk
- Early detection and management of complications
- Avoidance of nephrotoxic medications or volume depletion

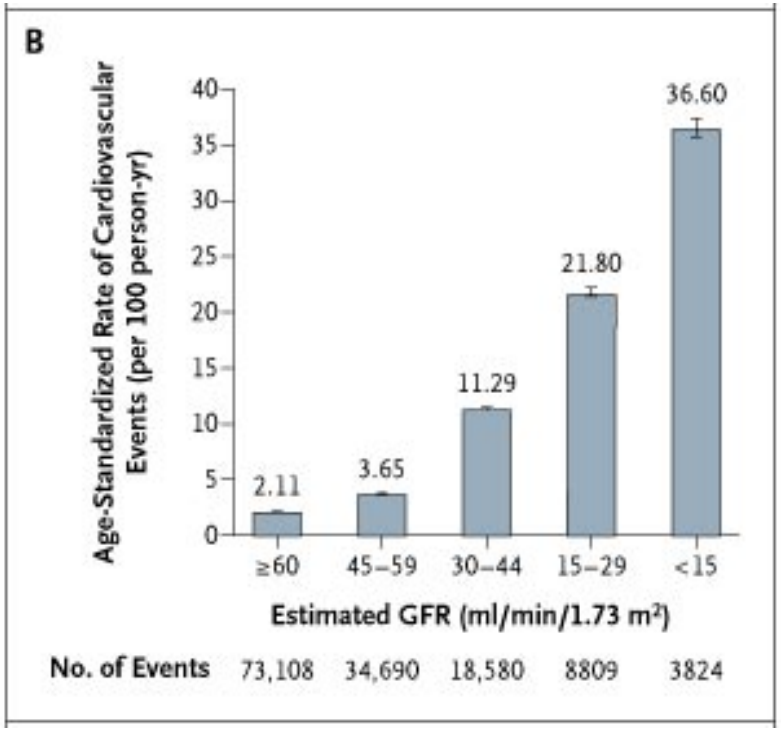
Chronic Kidney Disease (CKD) Management in General Practice, 3rd edition. Kidney Health Australia: Melbourne, 2015

CKD and the risk of death,CV events and hospitalisation

All cause mortality



Cardiovascular mortality

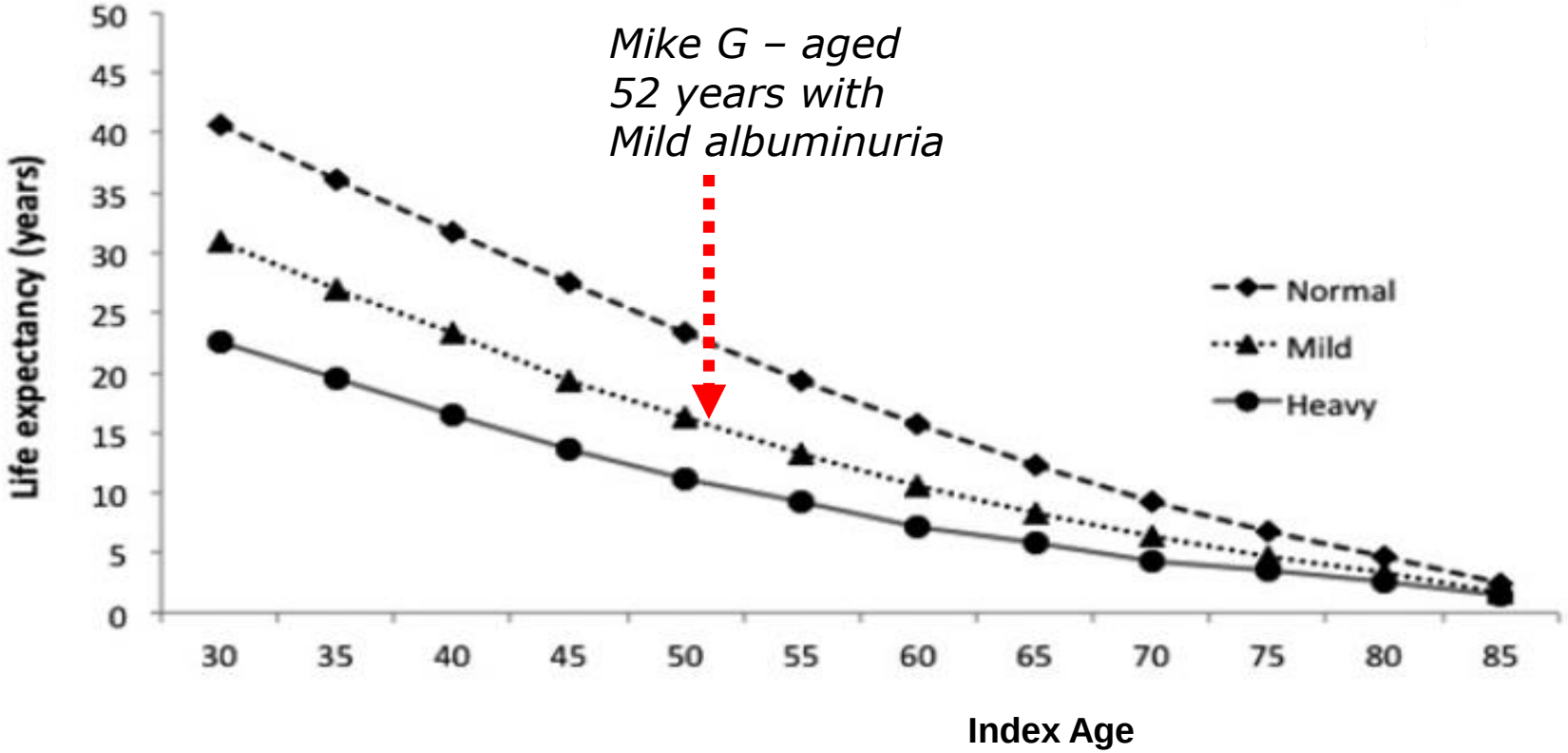


N = 1,120,295

Go et al N Engl J Med 2004; 351:1296-1305

Kaiser Permanente Renal Registry

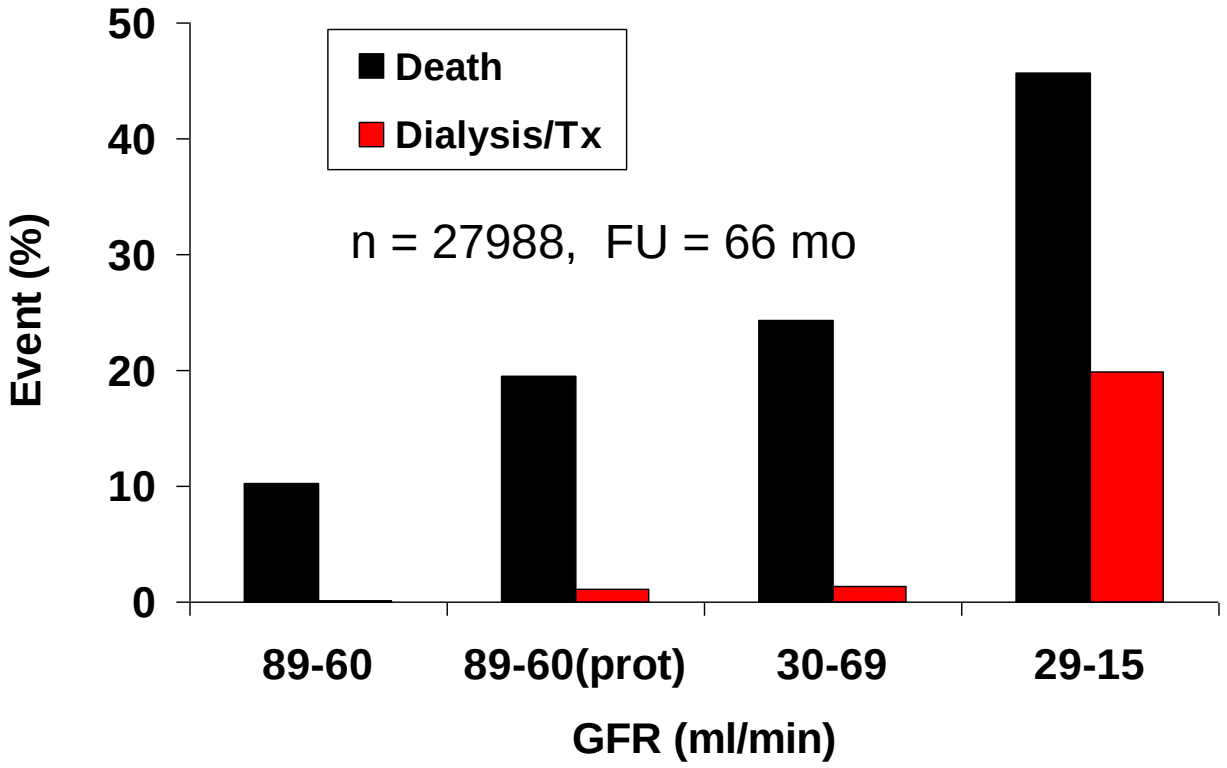
Proteinuria is related to life expectancy*



*Observational study of 375,325 men without end stage kidney disease followed for up to 7 years

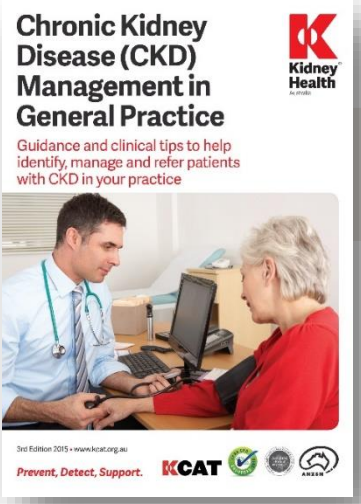
Turin et al, Am J Kidney Dis 2013;61:644-648

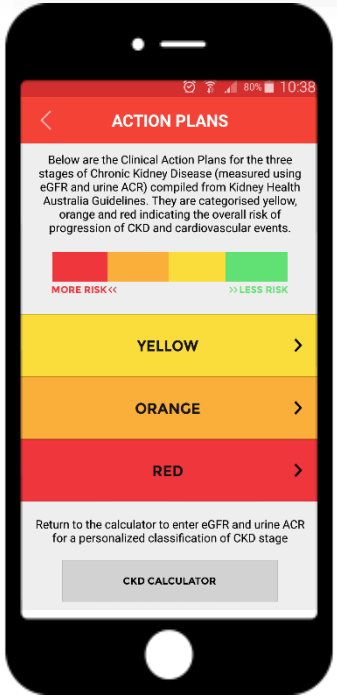
Kidney & cardiovascular outcomes in patients with CKD Kaiser Permanente Longitudinal Study



Patients with CKD are 20 times more likely to die from cardiovascular events than survive to reach dialysis

Keith et al; Arch Int Med 2004





Yellow Clinical Action Plan

Monitoring ✓ 12 monthly clinical review

Clinical assessment	✓Blood pressure ✓Weight
Laboratory assessment	✓urine ACR ✓Biochemical profile including urea, creatinine, electrolytes ✓eGFR ✓HbA1c (for people with diabetes) ✓Fasting lipids

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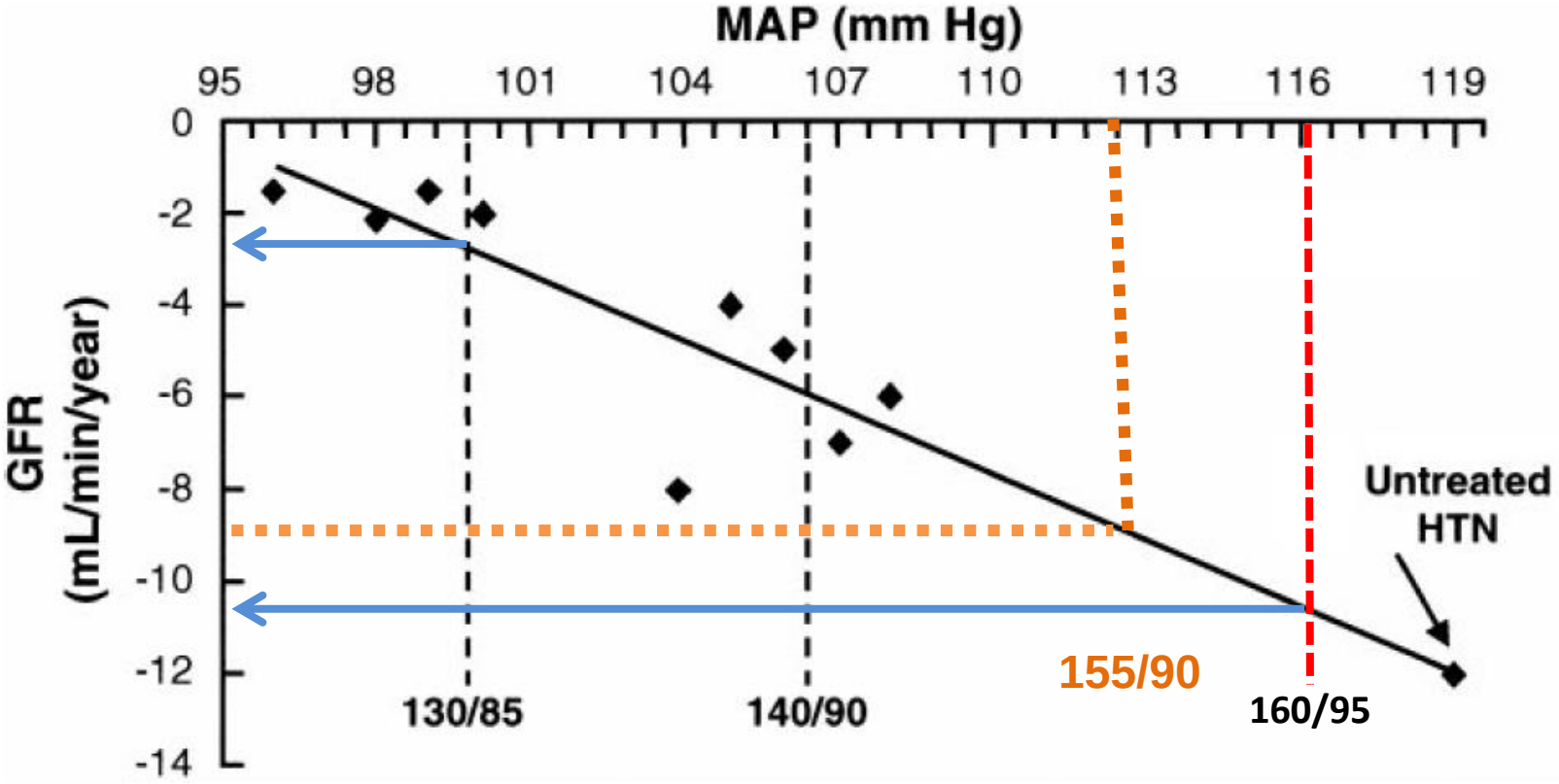
Adequate BP management delays the progression of CKD



If a patients blood pressure was consistently below target, the GFR loss per year would be reduced by 80%

Bakris et al., Am J Kid Disease, 2000

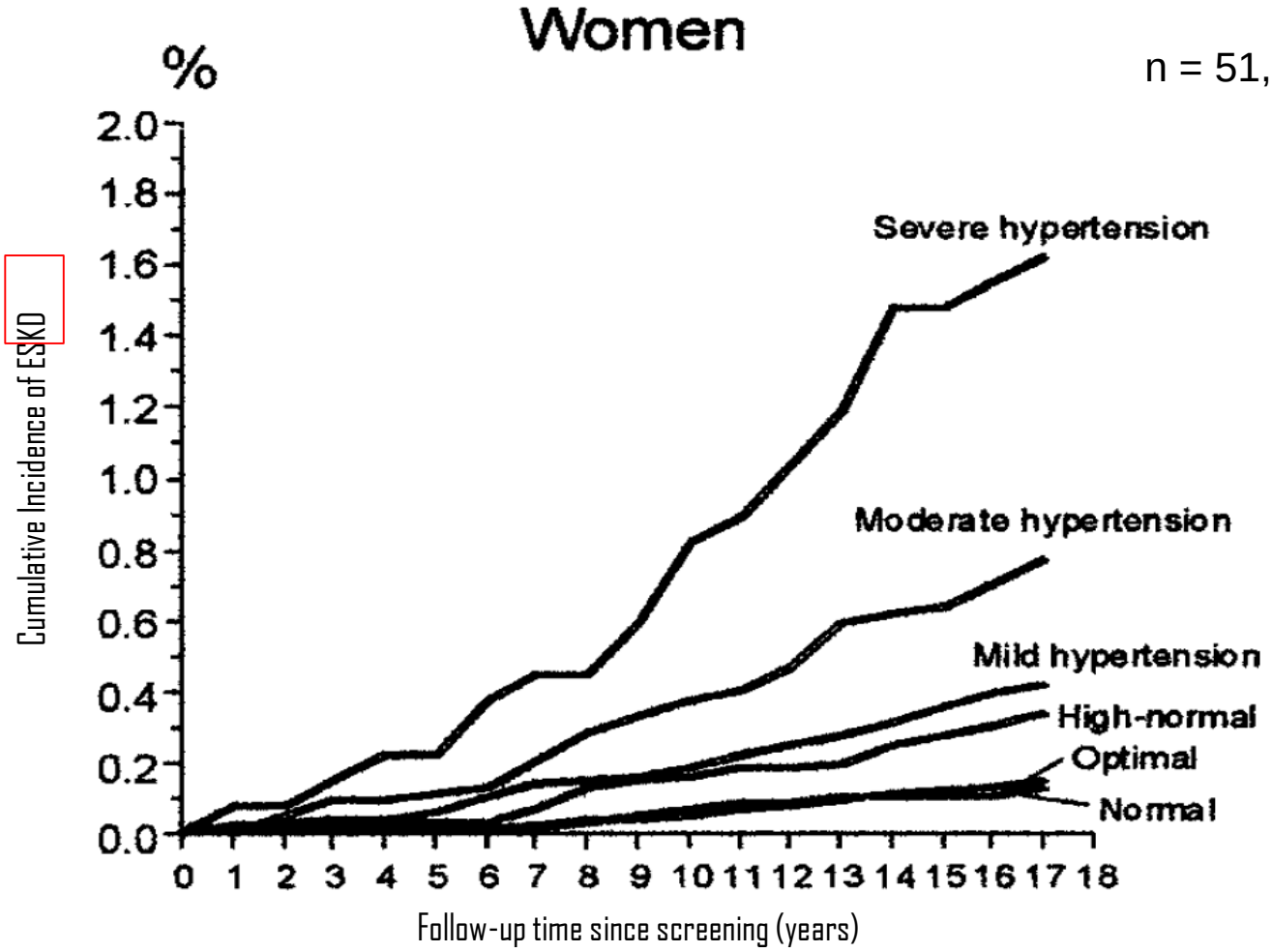
CKD risk factors: High blood pressure

High BP damages small blood vessels in the kidneys.
Starts the process described earlier causing fibrosis.

Or……*damaged kidneys cause high blood pressure and high blood pressure damages kidneys*

BP control

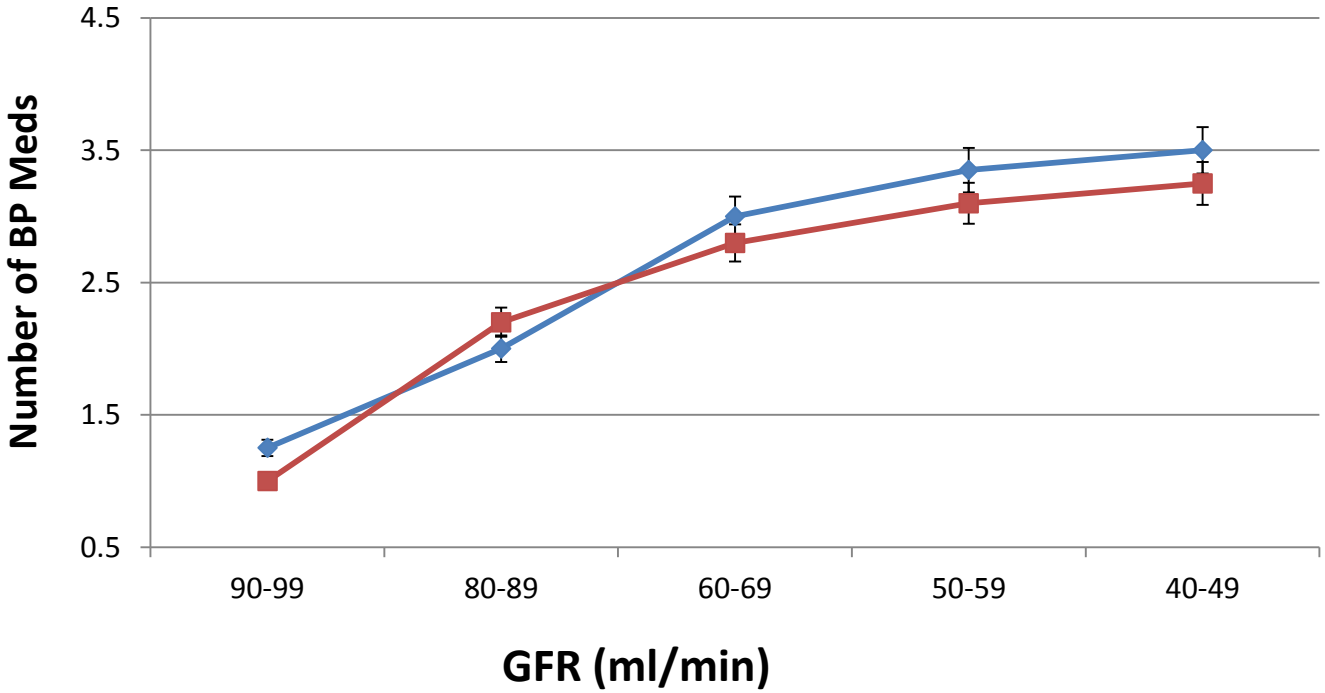
The cumulative incidence of end stage kidney disease is higher with more severe BP category



Tozawaw et al, Hypertension 2003;41:1341-1345

Treatment of blood pressure in CKD
Which agent and how many?

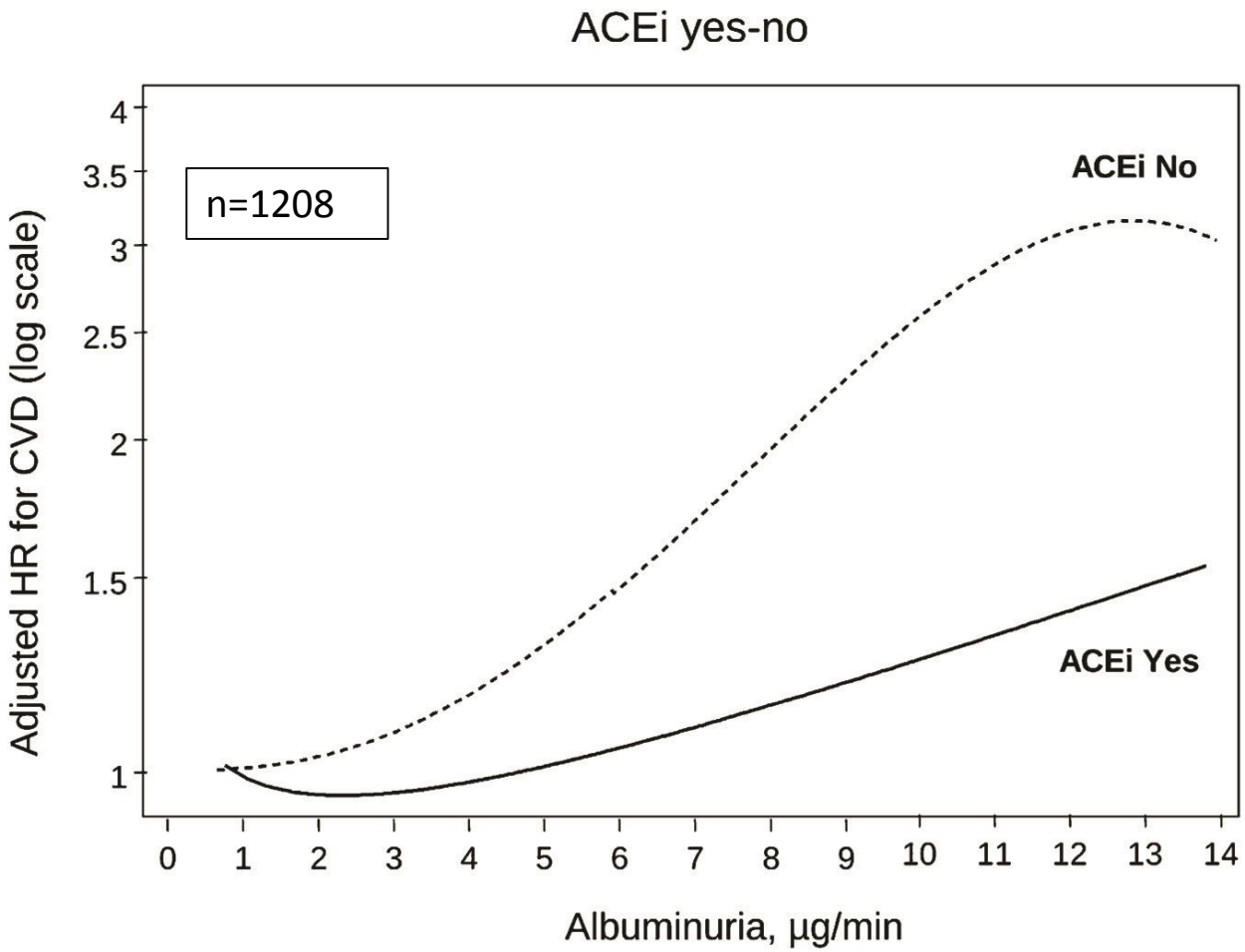
- RAAS Blockade - ACEi or ARB
  - Independent effect (tissue effects) over BP alone
- CKD patients often need multiple medications to achieve BP control
- Achieving below target BP is essential



Bakris et al, AJKD 2000;36:646-661

ACE inhibitors in Type 2 Diabetes with hypertension
The BENEDICT Trial

Adjusted HRs for major cardiovascular events
according to baseline albuminuria



Risk of CVD is significantly reduced

Ruggenenti et al; JASN 2012

Case study – Pt with DKD

If you started an ACEi or ARB, when would you recheck his chemistry & how much reduction in eGFR would you tolerate?

Check eGFR at 1 week and 1 month after starting

- ACEi & ARBs can cause reversible reduction in GFR at initiation of treatment

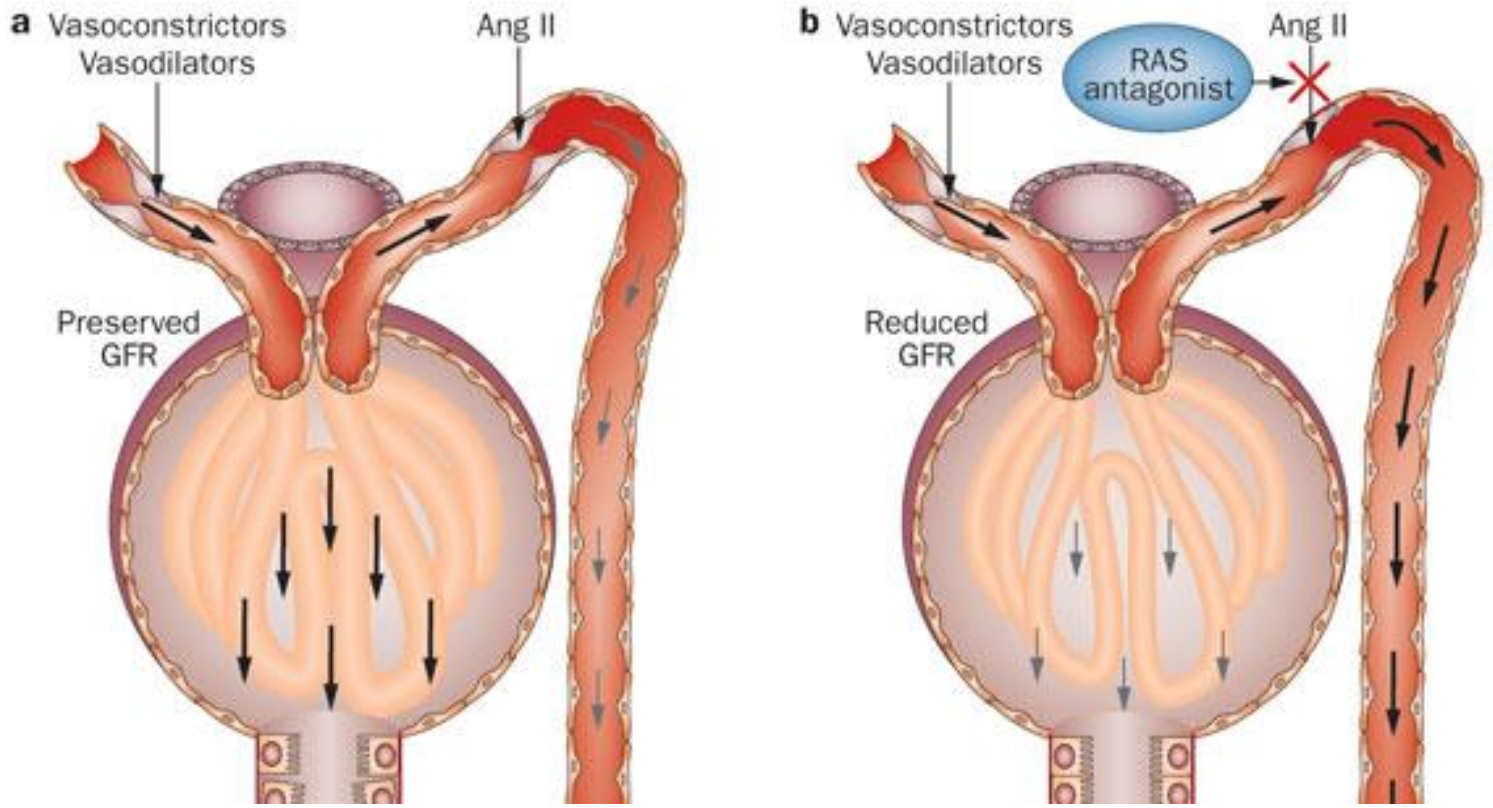
Tolerate a 25% decrease in eGFR*

- Continue ACEi or ARB if reduction is less than 25% and stabilises within two months of starting therapy
- Cease ACEi or ARB if reduction >25% below baseline
- In ceasing ACEi or ARB, consider referral to Nephrologist for bilateral renal artery stenosis
- All reductions in GFR with ACEi or ARB are reversible

* Bakris. Arch Int Med 2000; 160: 685

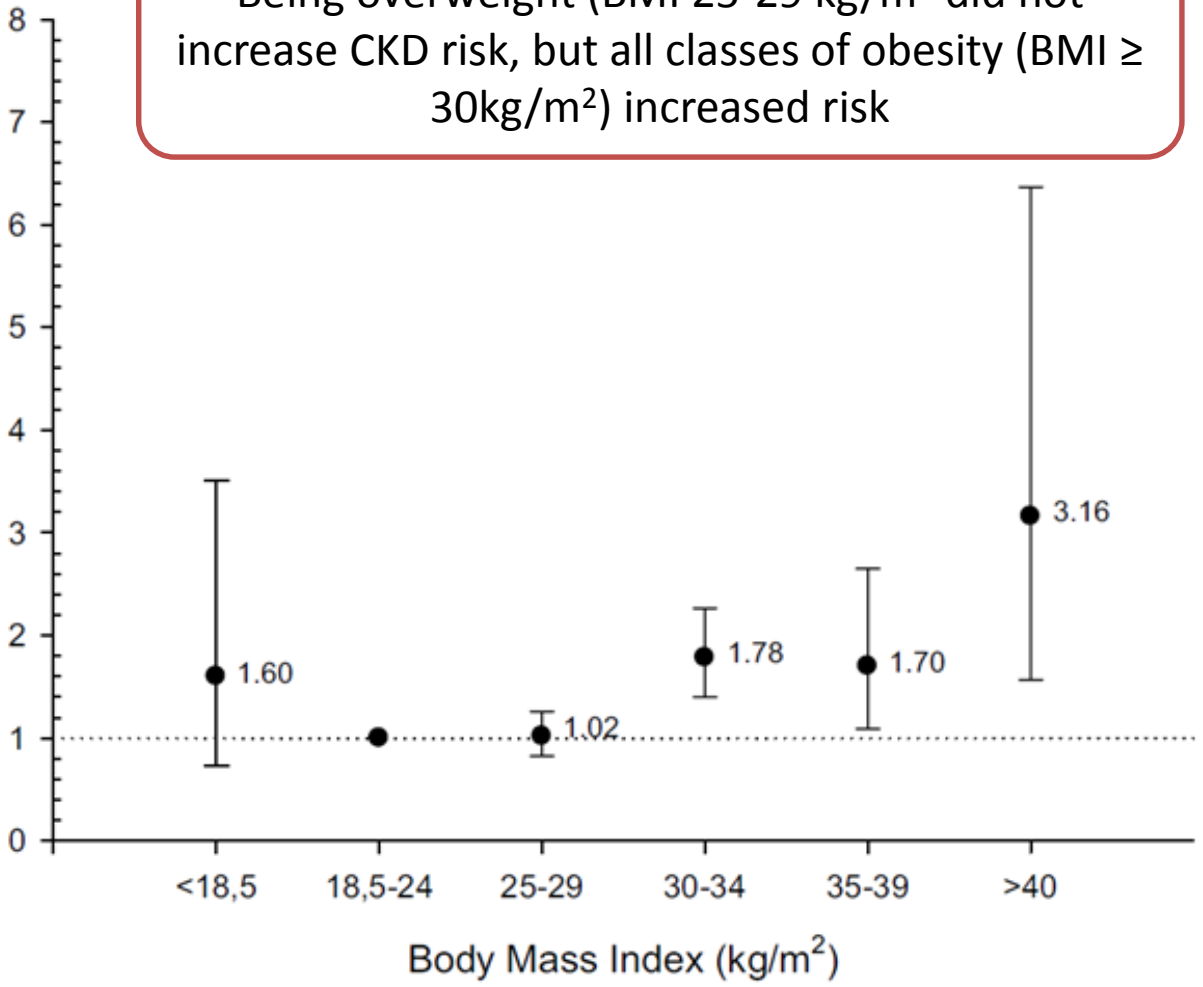
RAS Blockade

- Loss of renal efferent arteriolar vasoconstriction:
  - Acute decrease in intra-glomerular pressure → ***fall in GFR***



CKD risk factors: Obesity

Being overweight (BMI 25-29 kg/m^2 did not increase CKD risk, but all classes of obesity (BMI ≥ 30kg/m^2) increased risk



*CKD with eGFR <45mL/min/1.73m^2

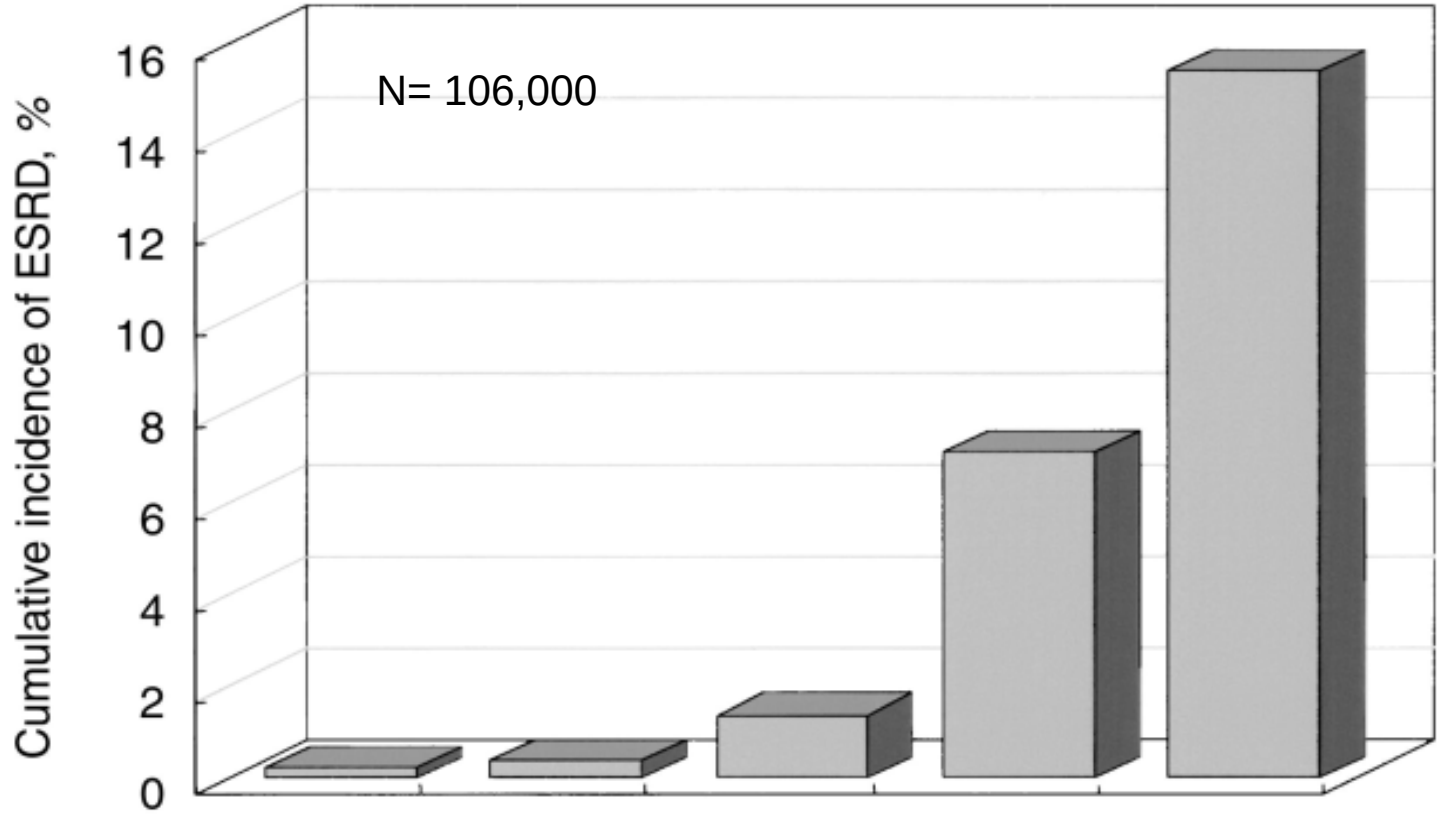
Hallan et al, Am J Kid Dis 2006

Risk factors - obesity

- Overweight (BMI 25.1-30) – 40% risk
- Obese (BMI >30) → 80% more likely to develop CKD compared to normal weight individuals*
- **Central obesity** more important than generalised
- Although not as powerful as diabetes or hypertension as a risk factor, obese subjects may be **more likely to develop albuminuria** and proteinuria
- Obesity = **greater difficulty** in achieving glycaemic & BP control

*Wang Y et al.. Kidney Int. 2008;73:19-33.

Risk of ESKD related to baseline proteinuria (dipstick) over 18 year period

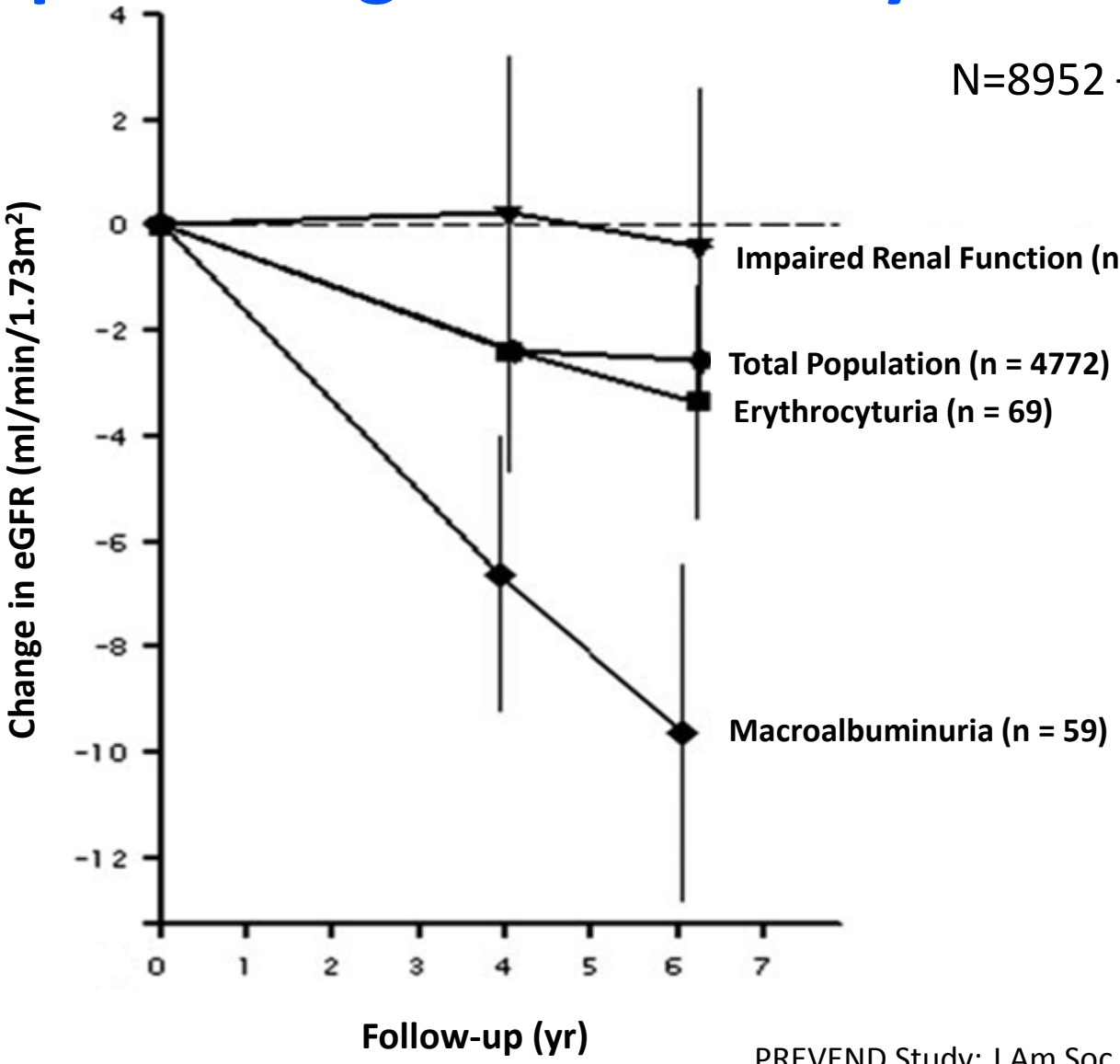


Proteinuria	–	±	+	2+	≥3+
Number of screened	86,253	10,000	4007	1072	357
Number of ESRD	185	38	55	76	55

Iseki et al, Kidney Int 2003;63:1468-1476

Macroalbuminuria is a better marker than GFR in predicting loss of kidney function

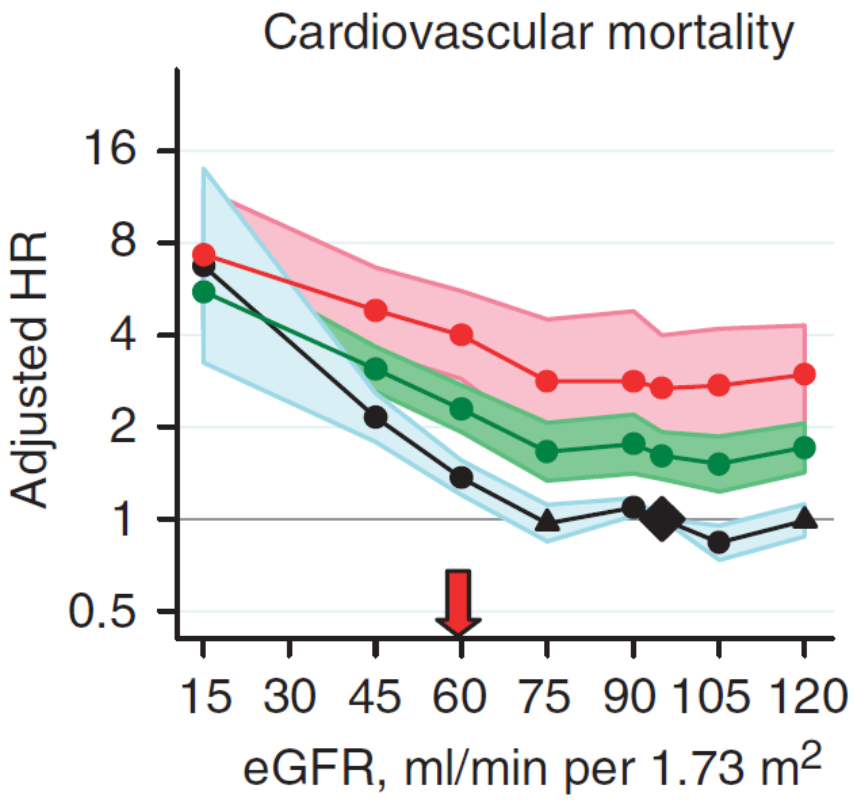
N=8952 – F/U 4yrs

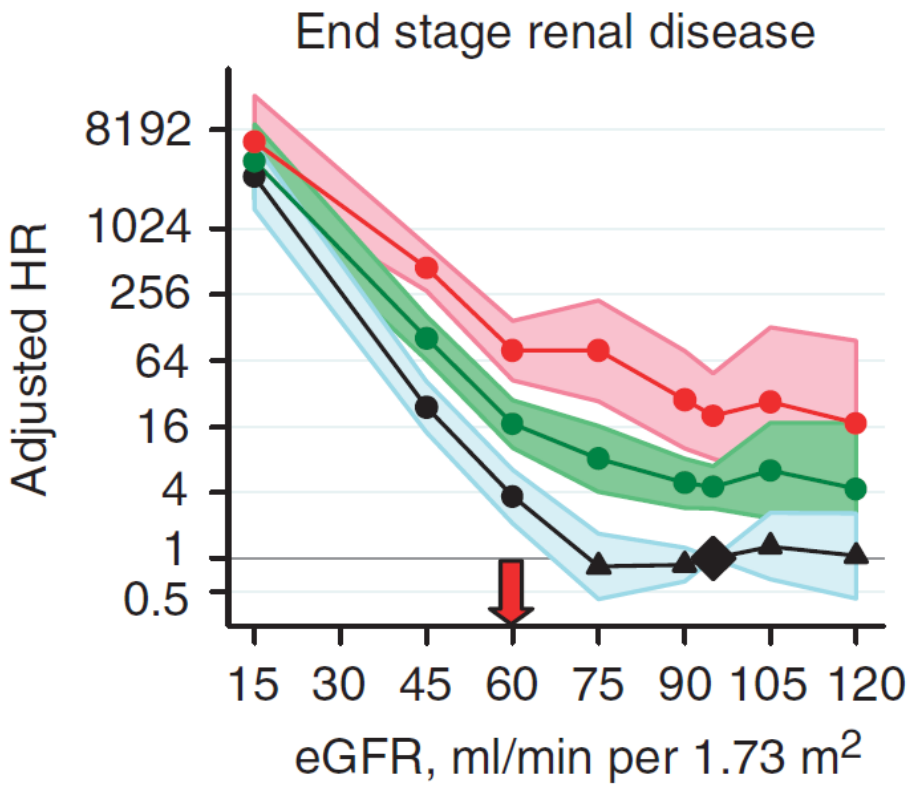


PREVEND Study; J Am Soc Nephrol 2006

Proteinuria

Blue – normal ACR
Green – microalbuminuria
Red - macroalbuminuria



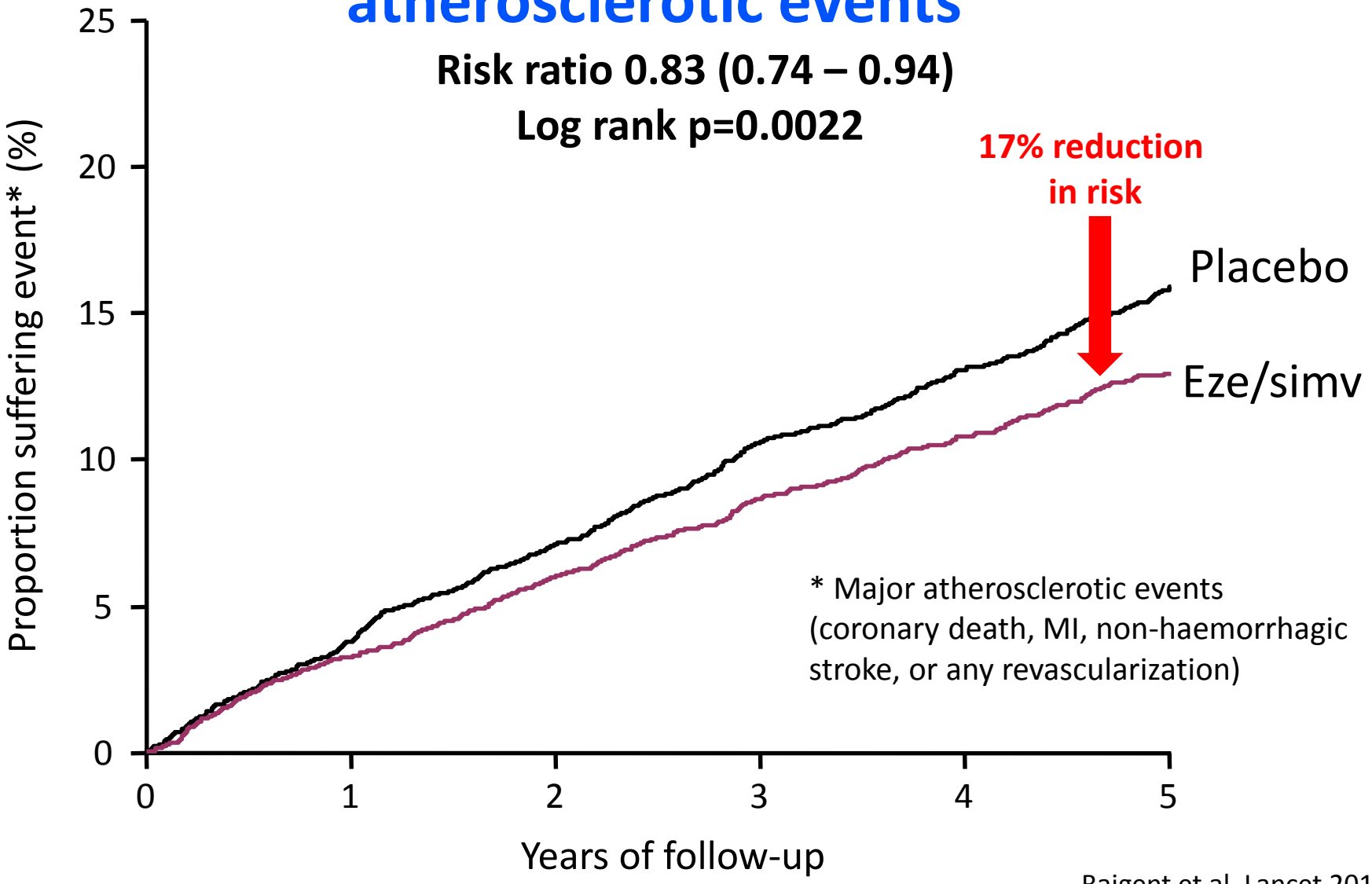


Note log scale on Y axis for Hazard Ratio

Adapted from Levey et al, 2010, Kidney International

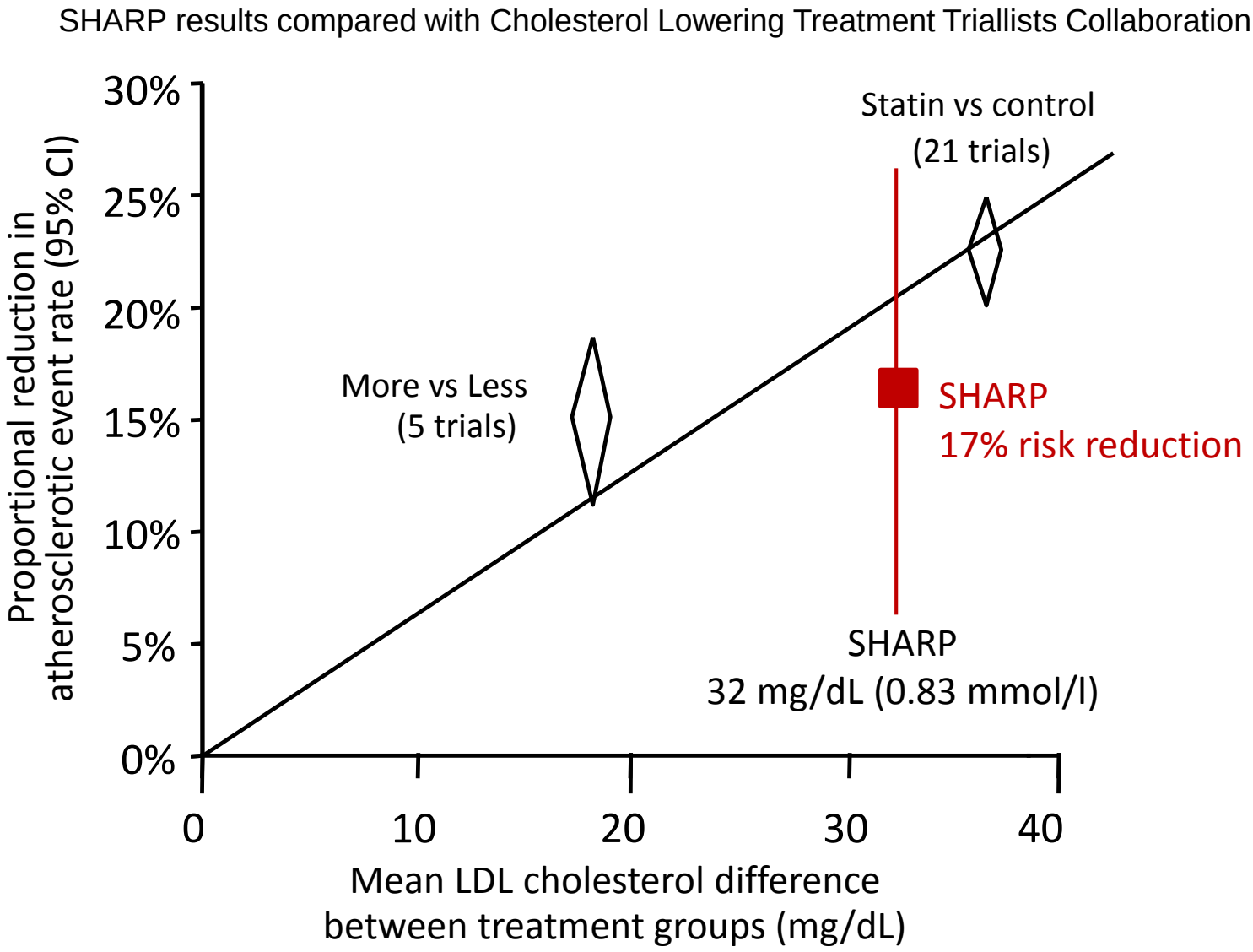
LIPID REDUCTION

SHARP results: 17% reduction in major atherosclerotic events



Baigent et al, Lancet 2011

SHARP results: consistent with results from previous cholesterol lowering trials



Mike Gs Medication list

Medications

- ACE/ARB
- HTN medication (more than two)
- Anti-lipid agents
- Allopurinol
- DM medication

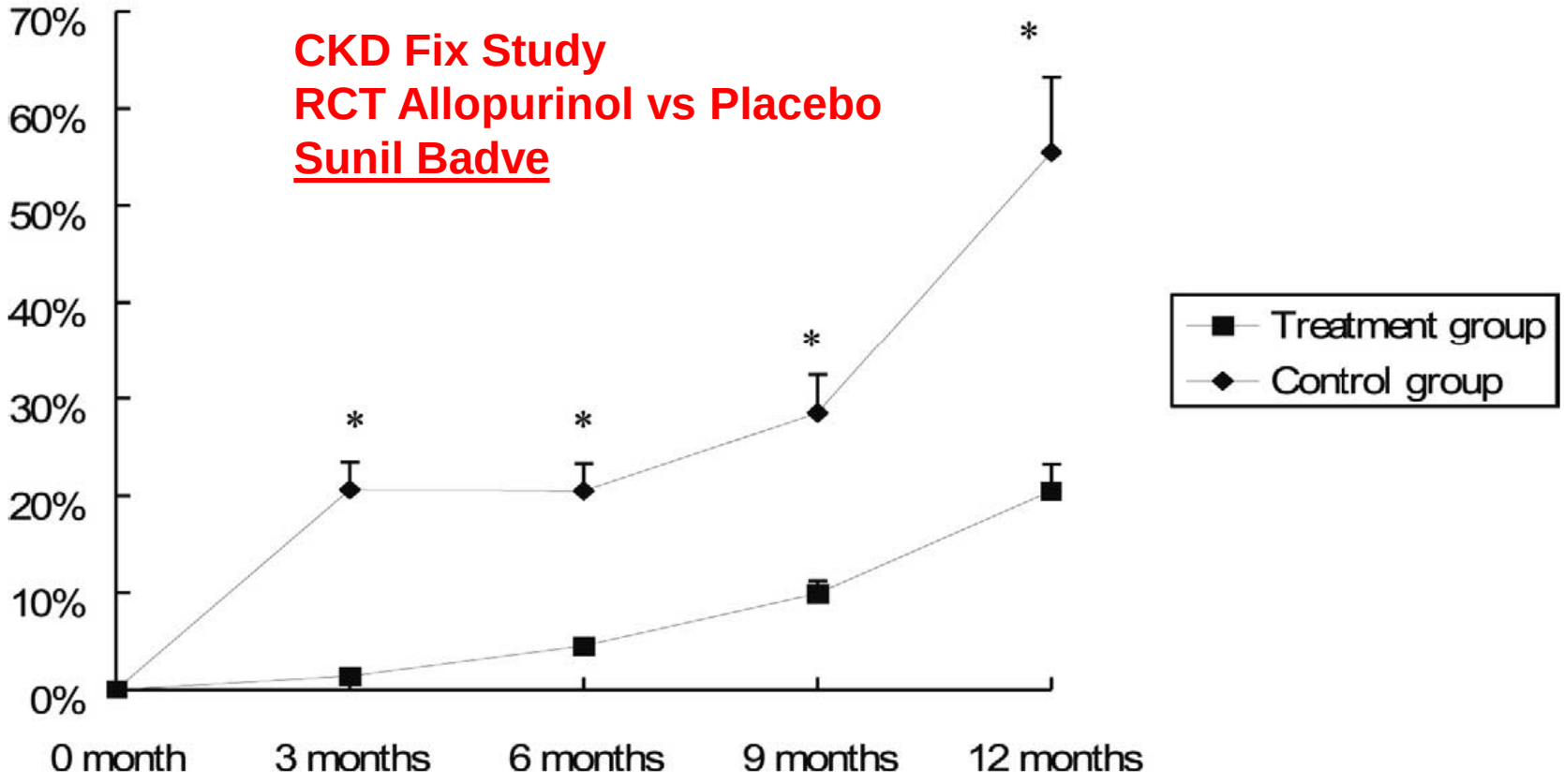
Risks

- **eGFR decline ↑K+**
- **Multiple medications and side effects**
- **CK Muscle cramps**
- **Rash or TEN**
- **Hypoglycaemia, lactic acidosis, worsening renal function**

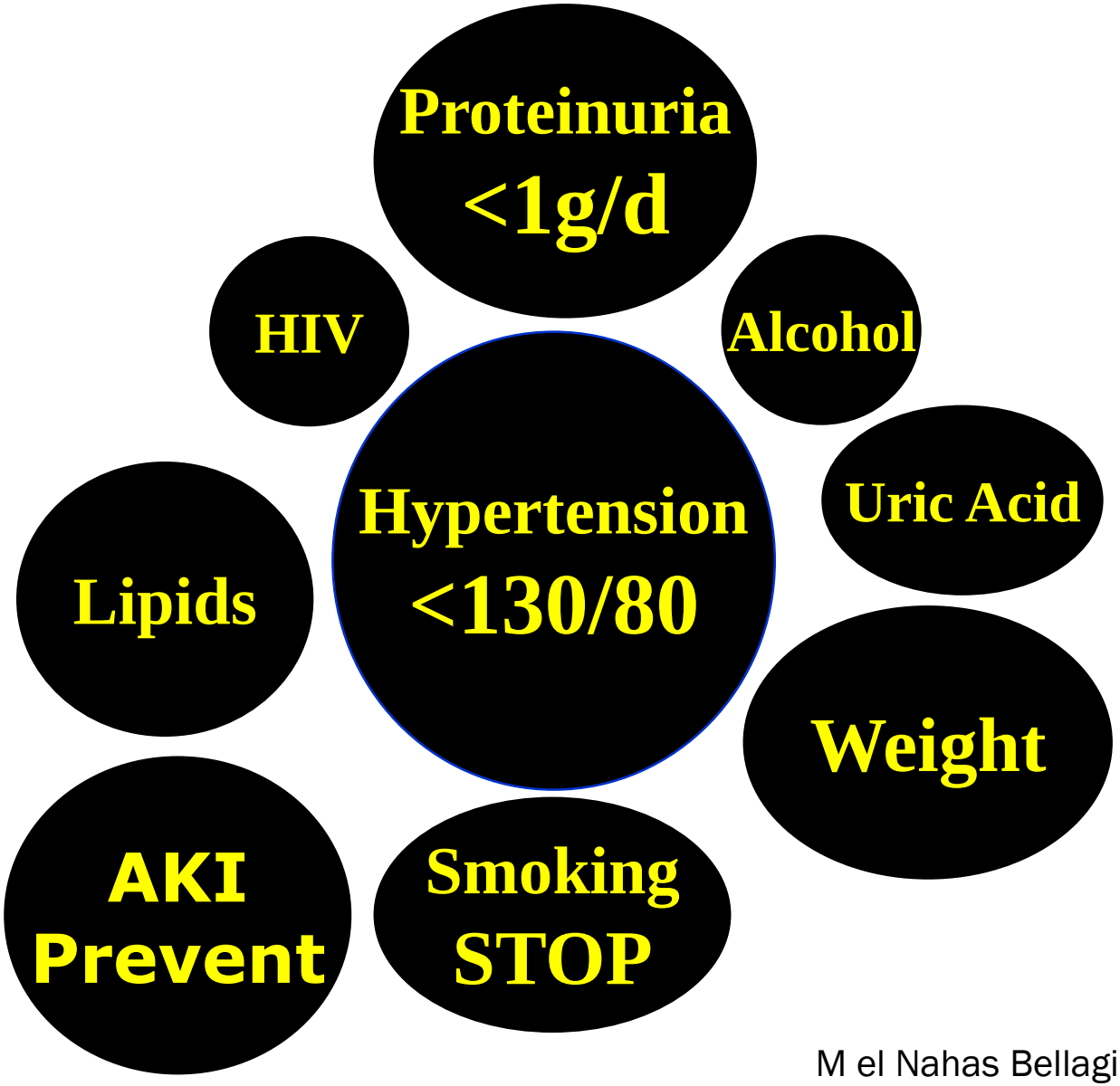
Use of Allopurinol in Slowing the Progression of Renal Disease Through Its Ability to Lower Serum Uric Acid Level

American Journal of Kidney Diseases, Volume 47, Issue 1, January 2006, Pages 51-59
Yui-Pong Siu, Kay-Tai Leung, Matthew Ka-Hang Tong, Tze-Hoi Kwan

CKD Fix Study
RCT Allopurinol vs Placebo
Sunil Badve

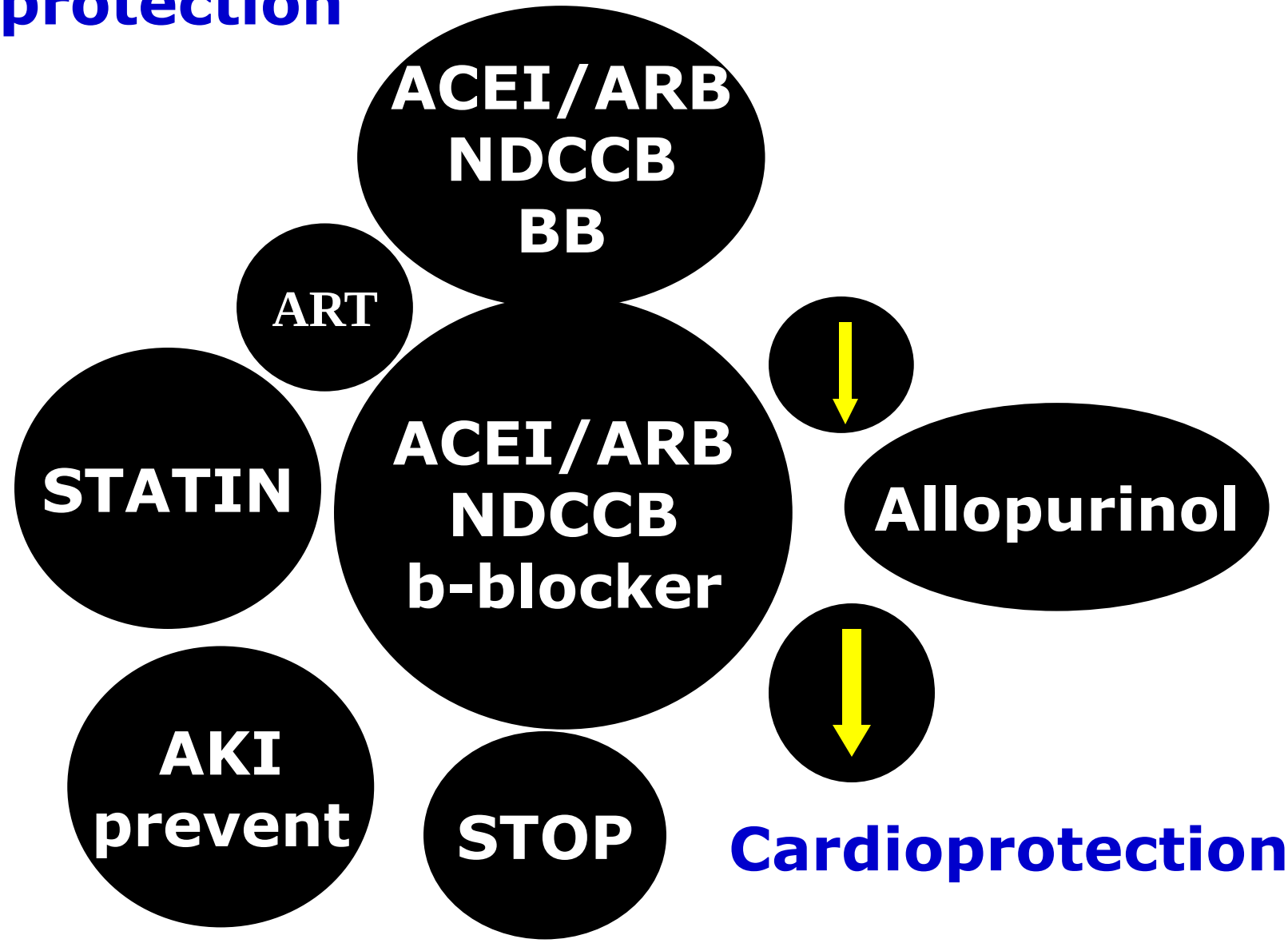


Mean percentage of change in creatinine levels in treatment and Control Groups *p<0.05 compared with baseline



M el Nahas Bellagio 2004
Modified 2018

Renoprotection



Cardioprotection

M el Nahas Bellagio 2004
Modified

What about future screening and determining risk of progression and follow up?

Using Predictive Models

- Multivariate equations derived with the goal of predicting absolute risk at a given time frame
  - Not an association study of a single risk factor or biomarker
  - Emphasis on prediction over biological association

- **Navdeep Tangri MD PhD FRPC**
- **A/Prof Division of Nephrology, University of Manitoba, Canada**

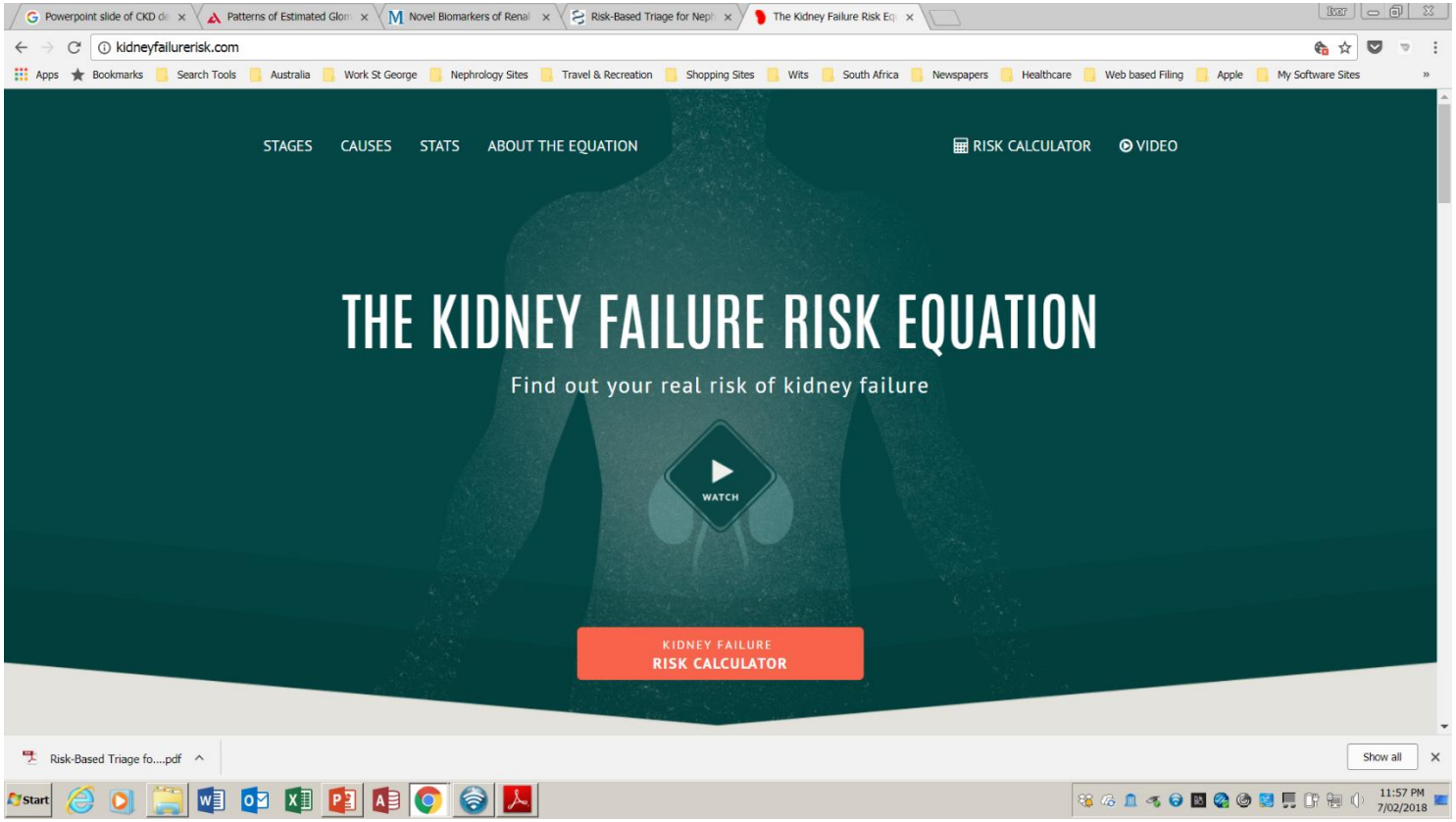
- **ASN New Orleans 2017**
- **Publications**

Why do we need models in CKD

Tangri et al. Curr Opinion Nephrology Hypertionsion 2013

1. Early and appropriate nephrology care – Nephrologist vs GP
2. Prognostic Information for patient and provider
3. Decision regarding intensity of care and timing of dialysis/transplantation education
4. Planning of vascular access
5. Planning Renal Supportive Care

Patient and Physician Tools – www.kidneyfailurerisk.com



Kidney Failure Risk Equation (KFRE)

Tangri et al JAMA 2011

- Developed lab based prediction models that accurately predicted progression of CKD (C stastics 0.84-0.91)
- Models used routine lab data

- **4 variable KFRE – Age , Gender, eGFR, ACR**
- **8 variable KFRE - + calcium, phosphate, bicarbonate and serum albumin**

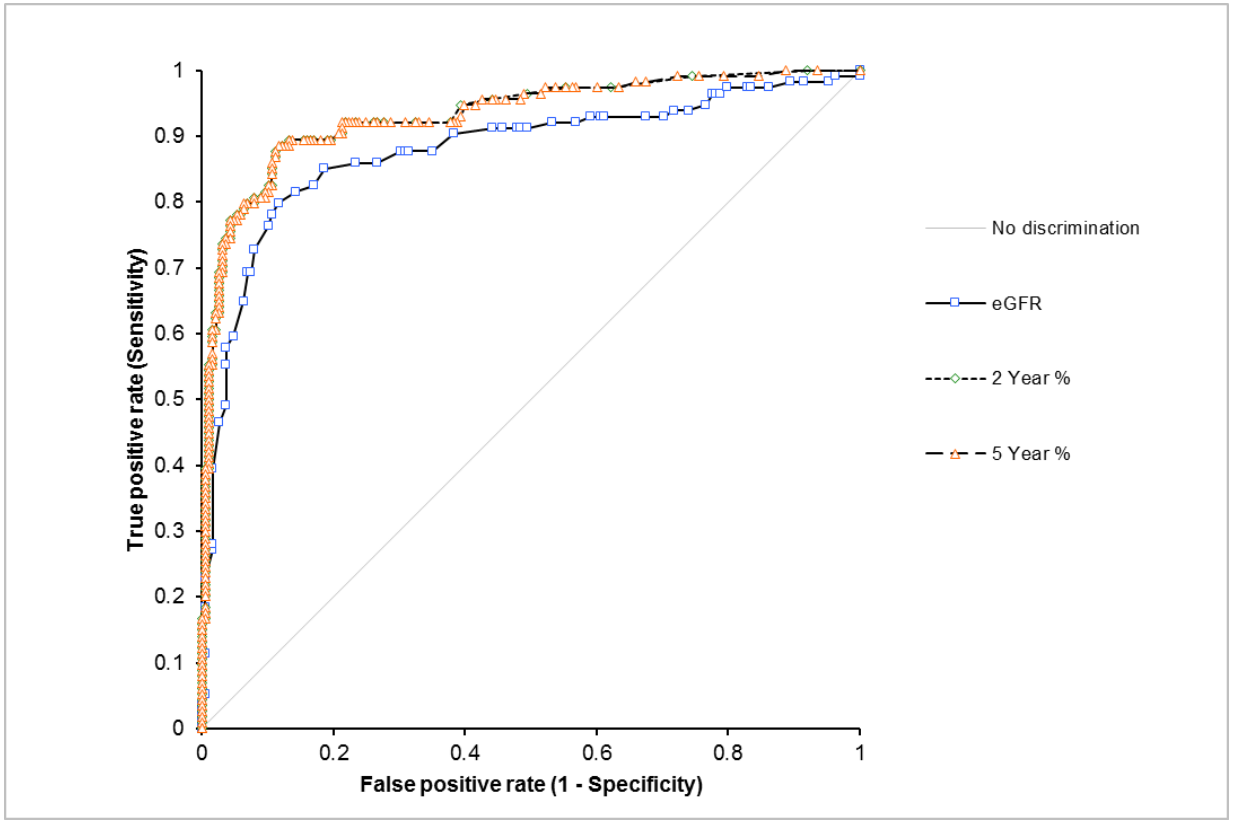
Risk Thresholds – KFRE vs eGFR

	Sensitivity	Specificity	PPV	NPV
KFRE Threshold 3% over 5 years	0.97	0.62	0.22	0.99
eGFR<45	0.84	0.54	0.17	0.97
KFRE Threshold 10% over 5 years	0.86	0.80	0.33	0.98
eGFR<30	0.62	0.84	0.30	0.95
C-Statistic for KFRE – 0.90 C-Statistic for eGFR = 0.78				

Tangri 2017, ASN

KFRE St George Hospital
eGFR, 2 Year %, 5 Year % by ESRD Outcome
n=302

Marina Wainstein, Manaul van Deventer et al

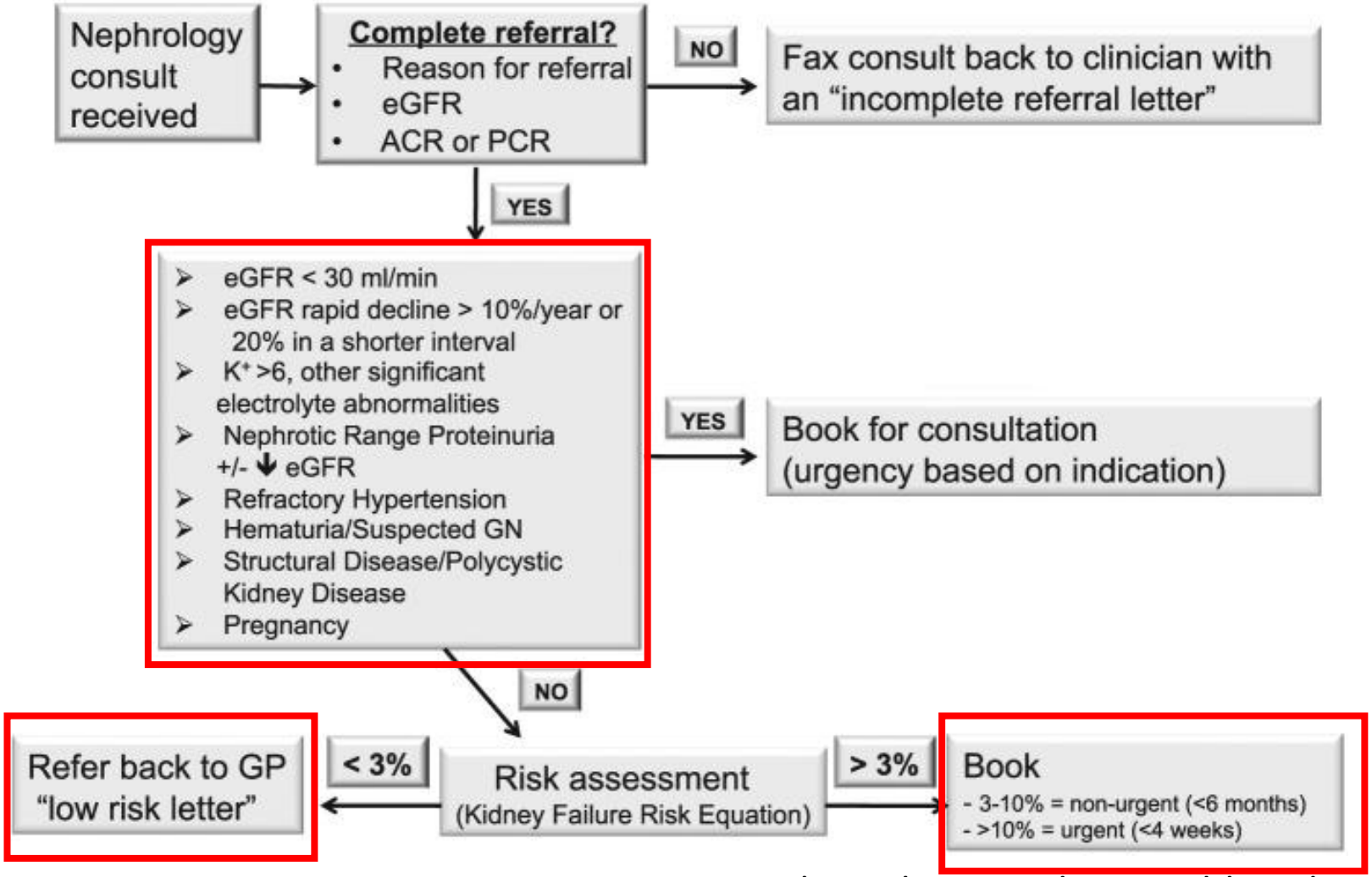


ESRD Outcome	n
No	188
Yes	114

Test	Area
eGFR	0.88
2 Year %	0.93
5 Year %	0.93

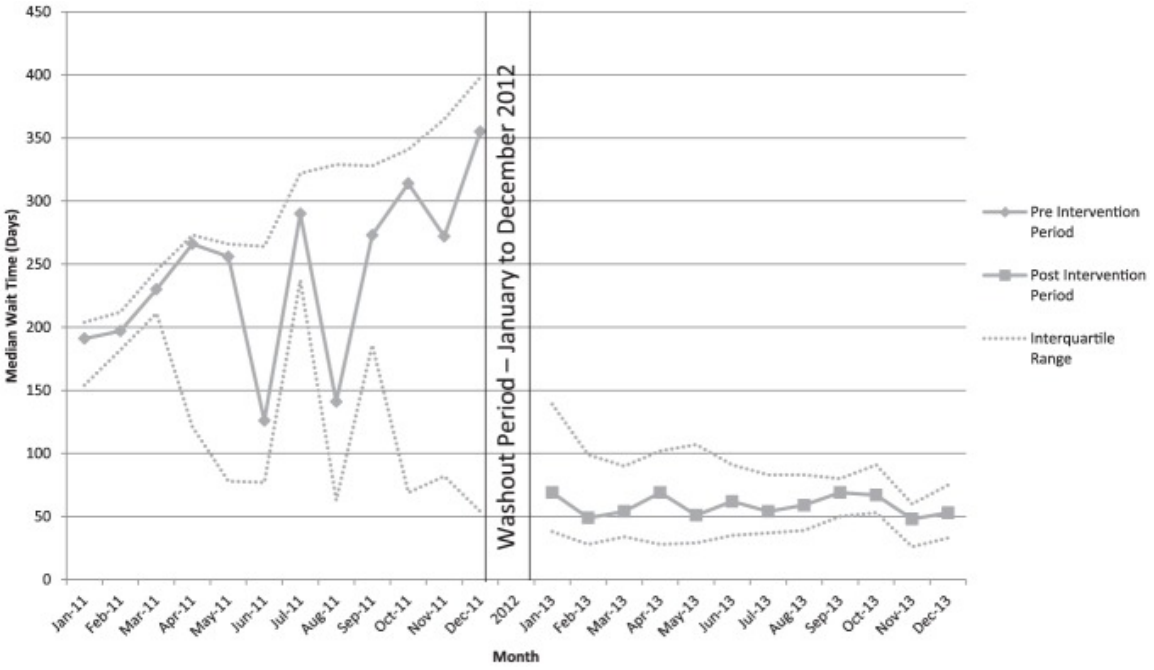
Abstract submitted to ASN 2018

Risk-Based Triage for Nephrology Referrals Using the Kidney Failure Risk Equation



Hingwala et al;Can J Kidney Health and Dis, 2017

Median wait time in pre-triage and post-triage periods.



Hingwala et al
Can J Kidney Health and Dis
2017

Note. Intervention resulted in statistically significant change in wait time ($P < .001$) and change in wait time trend (slope) post intervention ($P = .029$).

So, the value of KFRE ?

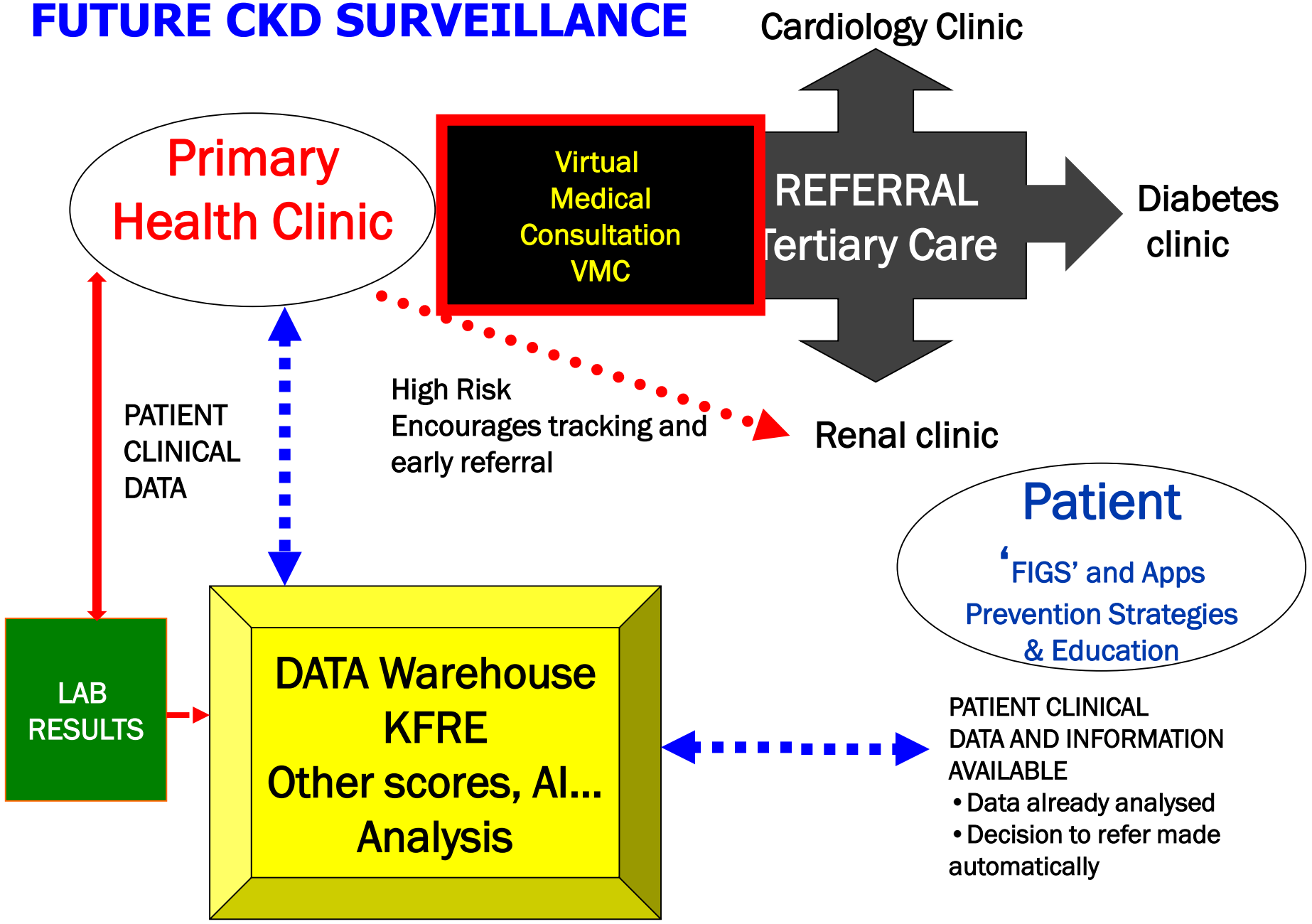
1. KFRE is still simple, highly accurate and validated across diverse populations
2. Implementations can reduce wait times, improve pre-dialysis care and align resources with risk!
3. Consider implementation KFRE in CKD care
4. More research in particular situations is required
   - When best to refer to ROC
   - When best to place an AVF

- **How and when should it be used?**

Implementation ?
Recommended (not evidence based)

- Triage of new nephrology referrals - (3% risk over 5 years)
  - >3% book in 6 months
  - >10% see within 4 weeks
- Entry into interdisciplinary care - (10% over 2 years)
- Modality education and preliminary planning - (20% over 2 years)
- Dialysis access insertion - (40% over 2 years)

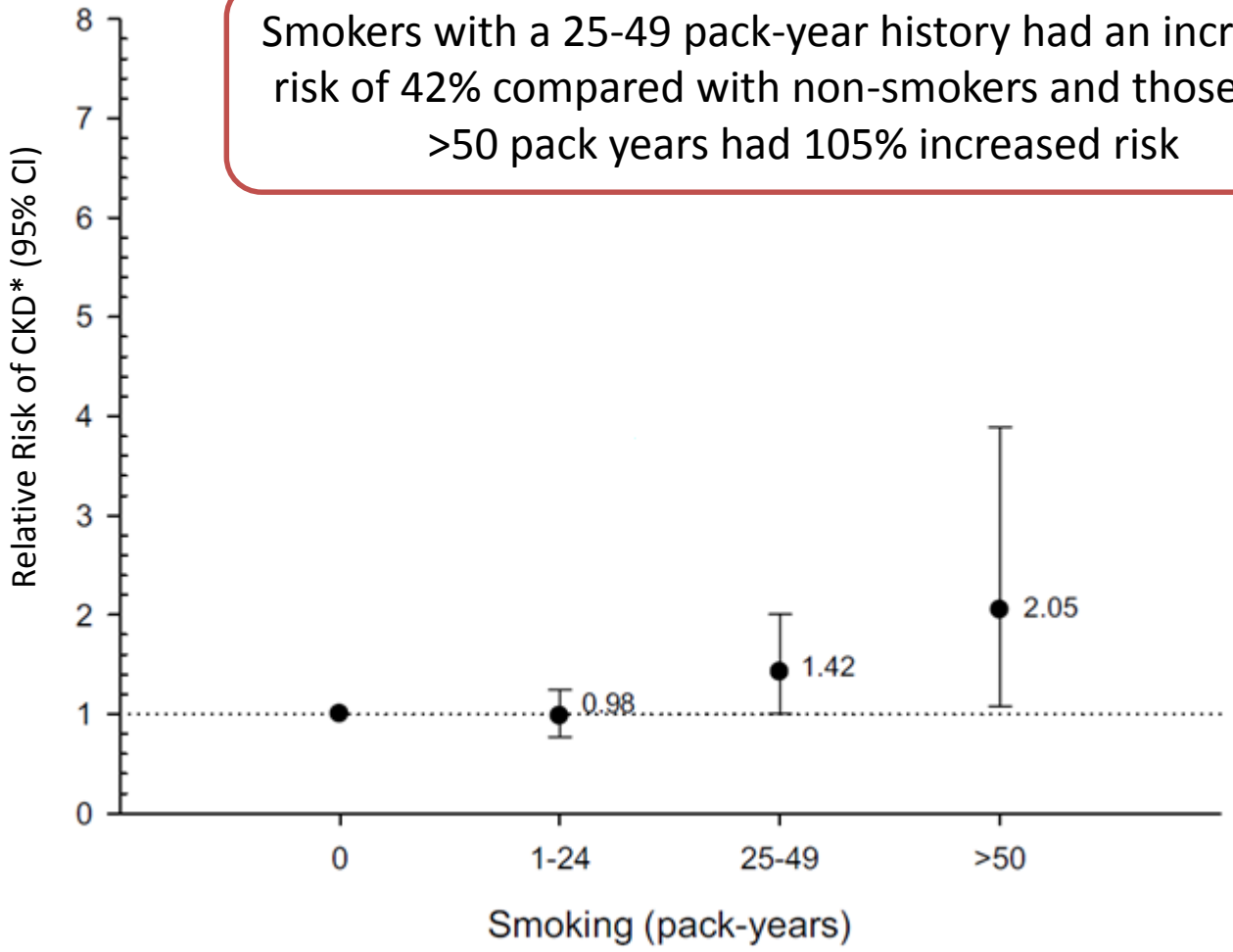
FUTURE CKD SURVEILLANCE



Smoking
Lifestyle factors
Family History
and
Biomarkers

CKD risk factor: Smoking

Smokers with a 25-49 pack-year history had an increased risk of 42% compared with non-smokers and those with >50 pack years had 105% increased risk



*CKD with eGFR <45mL/min/1.73m^2

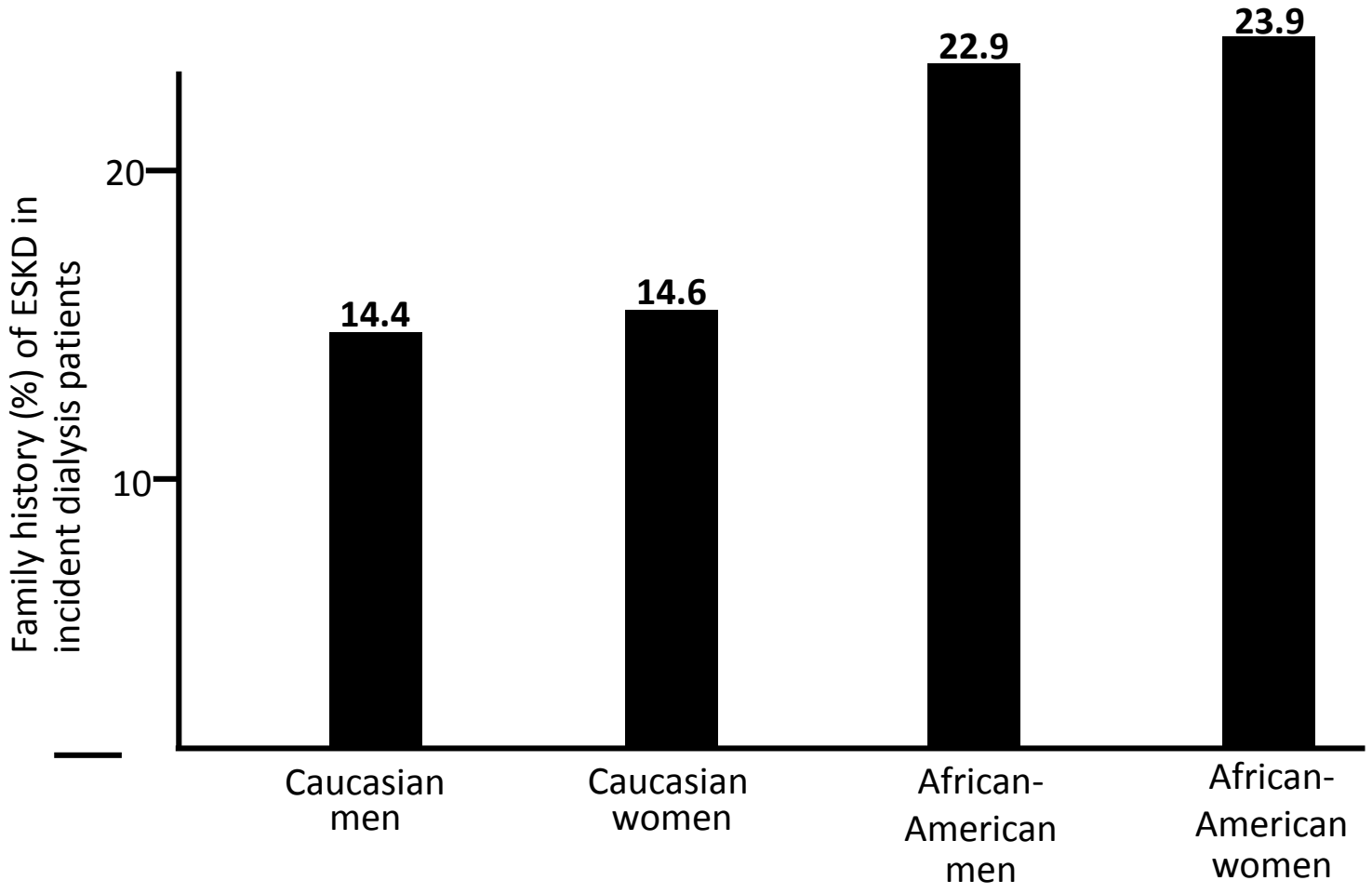
Hallan et al, Am J Kid Dis 2006

Lifestyle effects on BP

Modification	*Recommendation*	
Weight reduction	BMI 18-24.9 kg/m^2	4.4mmHg (for 5.1kg weight lost)
Dietary sodium restriction	Reduce dietary sodium intake to no more than 2.4g sodium (or 6g salt)	4-7mmHg (for reduction by 6g in daily salt intake)
DASH diet	Fruit, vegies, low saturated and total fat	5.5-11.4mmHg (5.5 for normotensives 11.4 for hypertensives)
Physical activity	Aerobic activity for 30-60mins/day, 3-5 days/week	5mmHg
Moderate alcohol consumption only	No more than 2 drinks per day (men) or 1 drink per day (women)	3mmHg (for 67% reduction from baseline of 3-6 drinks per day)

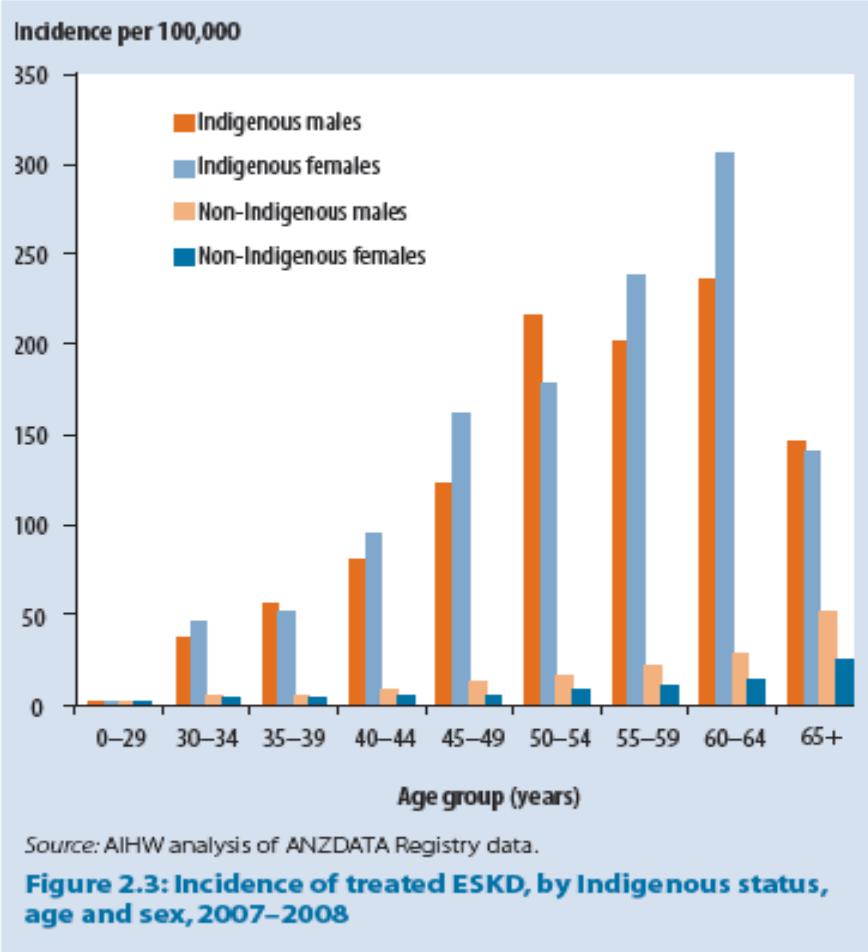
Tiberio M Frisoli et al Beyond salt; lifestyle modifications and blood pressure: European Heart Journal (2011) 32, 3081–3087 doi:10.1093/eurheartj/ehr379

CKD risk factors: Family history



Freedman et al., JASN 1997

CKD risk factors: Aboriginal or Torres Strait Islander Origin



Source: AIHW analysis of ANZDATA Registry data.

Figure 2.3: Incidence of treated ESKD, by Indigenous status, age and sex, 2007–2008

Indigenous Australians starting treatment for ESKD

Australian Institute of Health and Welfare, 2011

Biomarkers of Chronic Kidney Disease

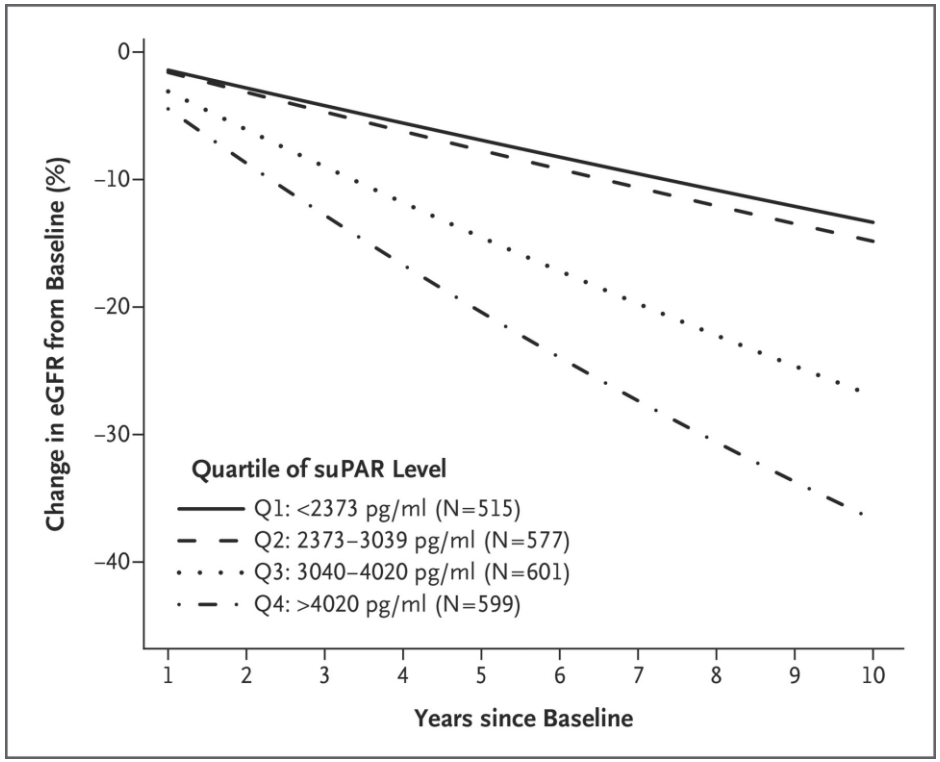
- Serum creatinine and albuminuria form the core of most predictive models of CKD and risk of progression BUT alterations relatively late in the disease trajectory and thus are NOT suitable for very early diagnosis of CKD.
- New Biomarkers – more predictive early disease
  - Cystatin C
  - β-trace protein (BTP)
  - Neutrophil gelatinase-associated lipocalin (NGAL)
  - Kidney injury molecule 1 (KIM-1)
  - Liver-type fatty acid–binding protein (L-FABP)
  - Asymmetric dimethylarginine (ADMA)
  - Uromodulin
  - micro RNA

Schema for Discussion Novel Biomarkers

Biomarker		Sample		Outcome	
Group	Name	Blood / Urine	Image	Renal	CVD / Death
FILTRATION	BTP – β trace protein B2M- β 2microglobulin				
EXCRETION	Na + – sodium K+ - Potassium				
TUBULAR INJURY	NGAL/KIM-1/L-FAB/ NAG				
INFLAMMATION	suPAR FLC				
MINERAL METABOLISM					
ARTERIAL DISEASE					
GENTETICS					

suPAR (Soluble Urokinase-type Plasminogen Activator receptor) and CKD Progression

Hayk et al N Engl J Med 2015; 373:1916-1925
DOI: 10.1056/NEJMoa1506362



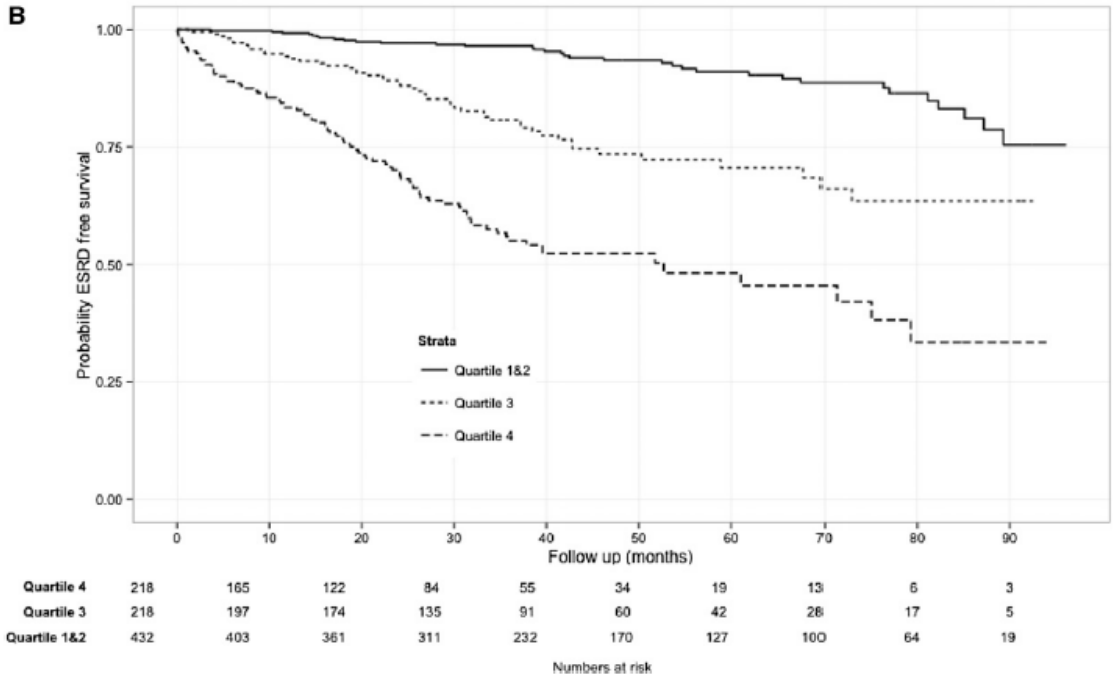
2292 Individuals undergoing heart Catheterisation
1335/2292 with eGFR >60ml/min/1.73m2

RESULTS
A higher suPAR level at baseline was associated with a greater decline in the eGFR during follow-up

CONCLUSIONS
An elevated level of suPAR was associated with
incident CKD and an
accelerated decline in eGFR

Serum FLC and CKD Progression

Richie J cJASN 2015



872 Participants in the UK CRISIS study (Chronic Renal Insufficiency Standards Implementation Study)

A strong independent relationship between high FLCs Levels and ESKD Peformance as a prognostic marker yet to be assessed

Conclusions

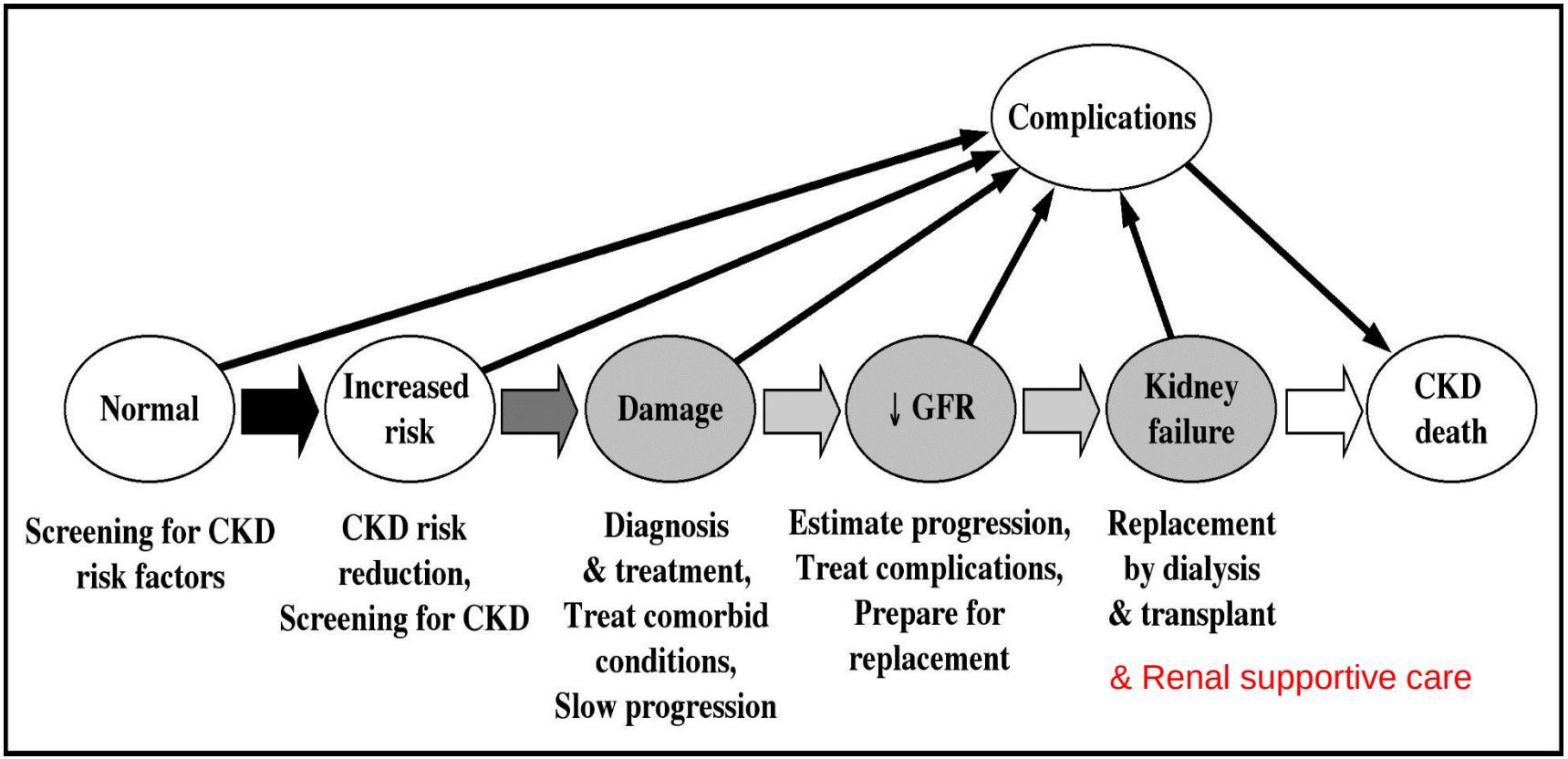
An elevated serum combined Ig free light chain level is an independent risk factor formortality and

Summary Biomarkers

- A number of biomarkers are emerging
- Many show relationships with kidney function and long term outcomes
- The ability of biomarkers to enhance our ability to diagnose, prognosticate progression of CKD beyond what is possible using existing measures of eGFR and albuminuria is uncertain
- suPAR and FLC appear promising but more testing is needed

Summarise!!

Conceptual Model of CKD and Therapeutic Strategies

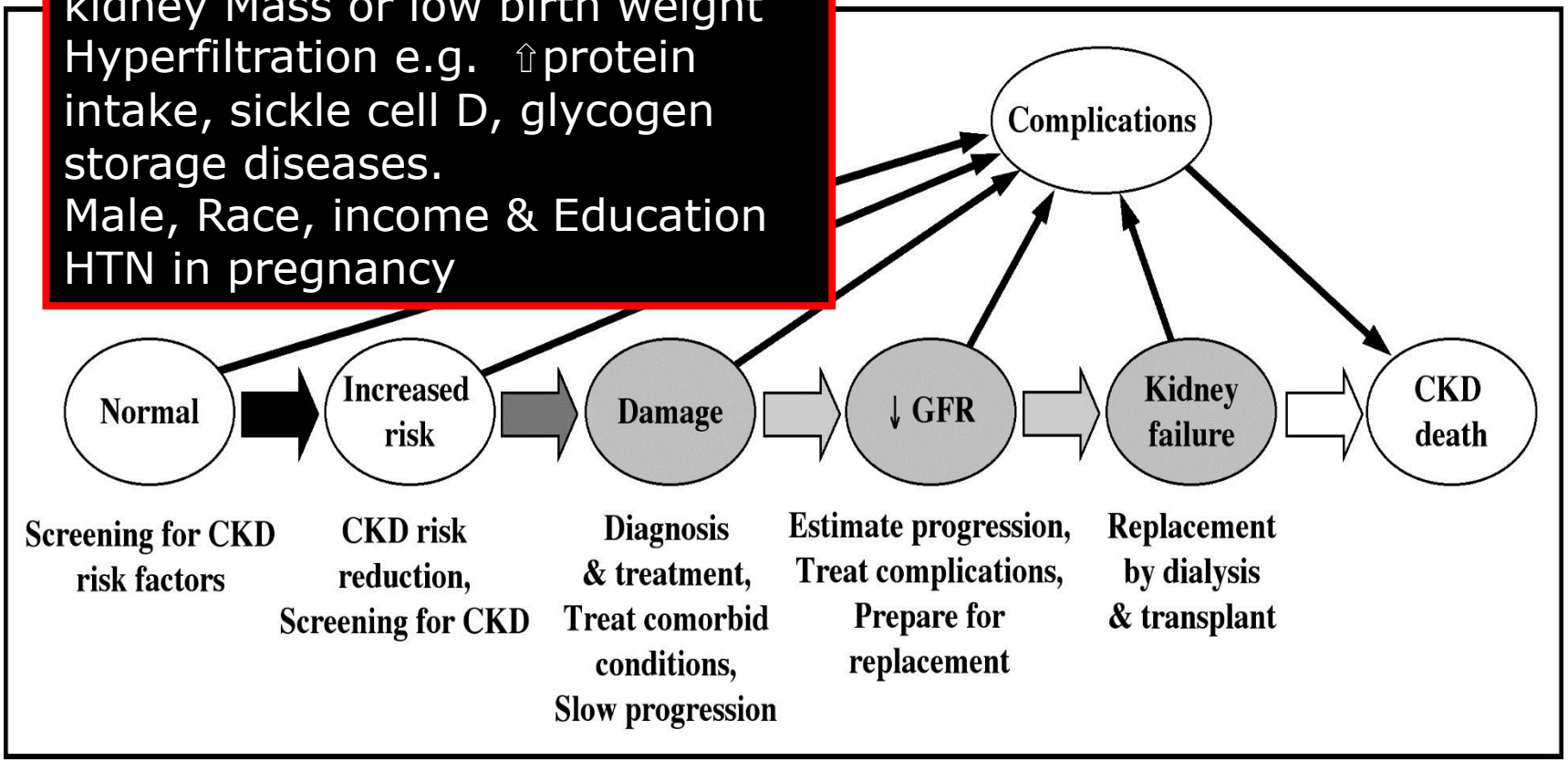


Levey et al. AJKD
2009-03-01, Volume 53, Issue 3, Pages S4-S16)

Risk Factors & CKD

Susceptibility Factors

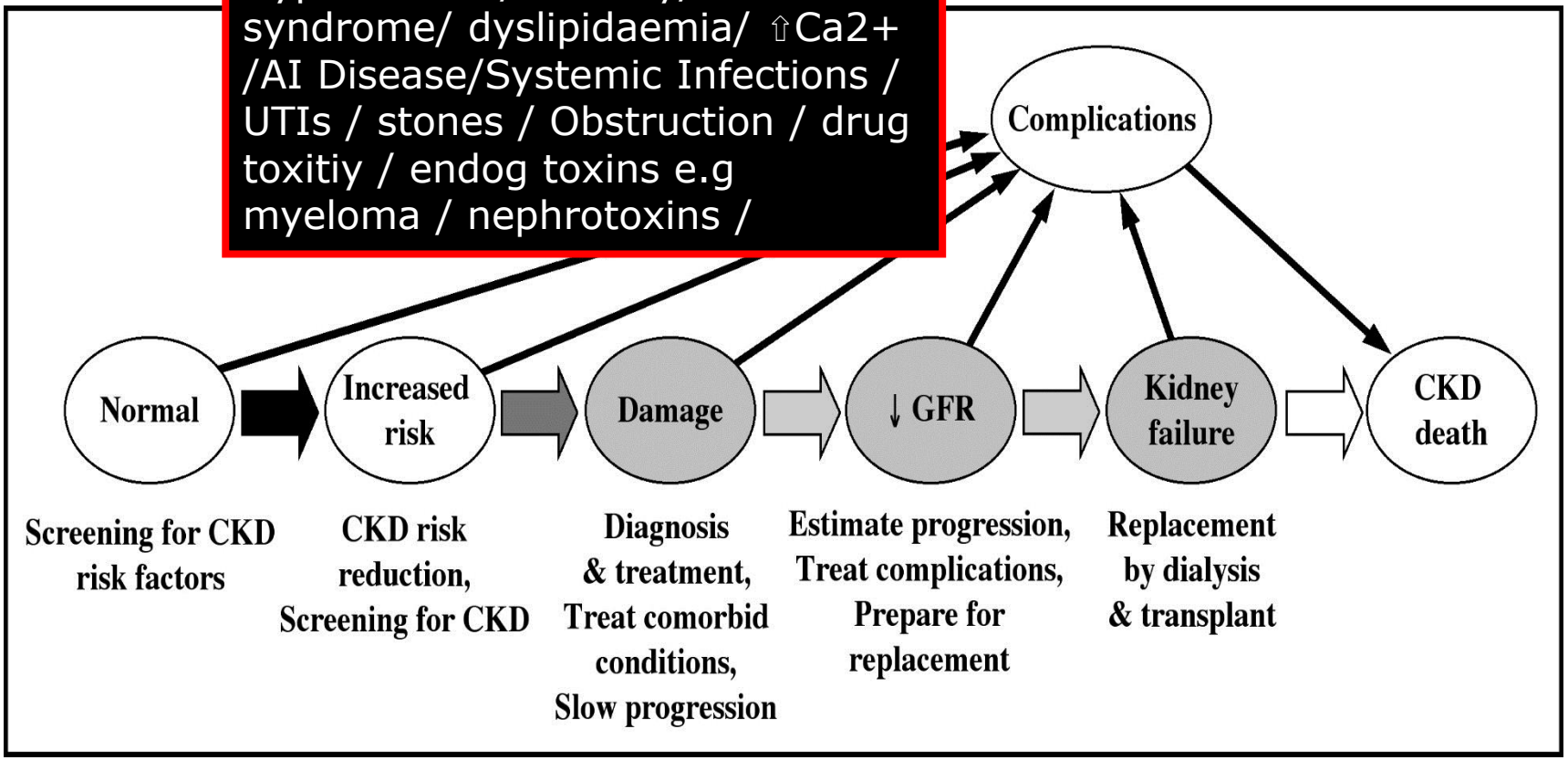
Age & Family Hx CKD ⇩
kidney Mass or low birth weight
Hyperfiltration e.g. ⇧protein intake, sickle cell D, glycogen storage diseases.
Male, Race, income & Education
HTN in pregnancy



Levey et al. AJKD
2009-03-01, Volume 53, Issue 3, Pages S4-S16)

Risk Factors & CKD

Initiation Factors
Older age Male / DM/ Hypertension/ Obesity/ Metabolic syndrome/ dyslipidaemia/ ⇧Ca2+ /AI Disease/Systemic Infections / UTIs / stones / Obstruction / drug toxitiy / endog toxins e.g myeloma / nephrotoxins /



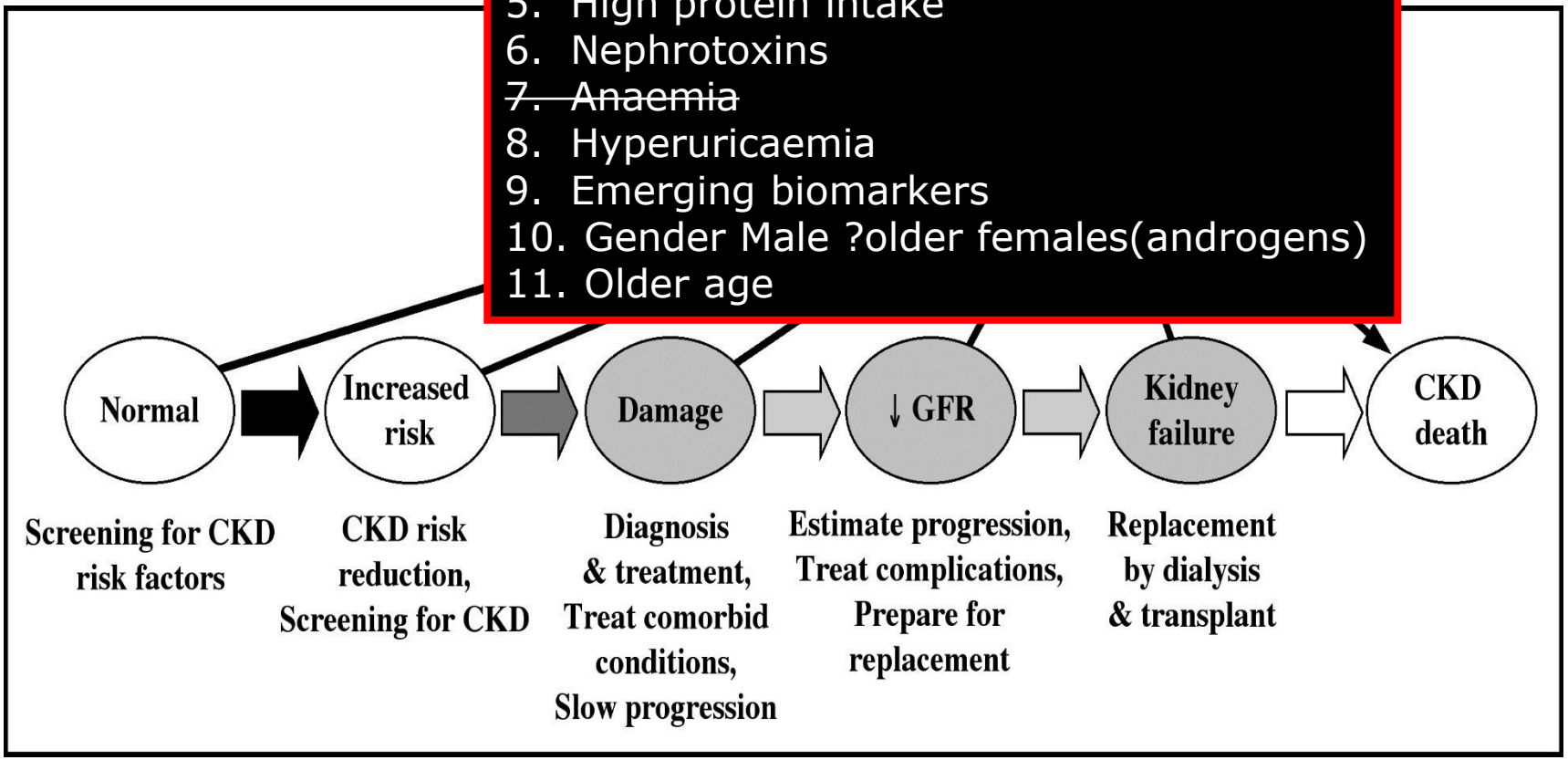
Tsai et al. Medicine
Volume 95, Number 11, March 2016

Levey et al. AJKD
2009-03-01, Volume 53, Issue 3, Pages S4-S16)

Progres KD

Progression Perpetuating Factors

1. Higher levels of proteinuria
2. Systolic Blood Pressure
3. Poor glycaemic diabetic control
4. Smoking
5. High protein intake
6. Nephrotoxins
7. ~~Anaemia~~
8. Hyperuricaemia
9. Emerging biomarkers
10. Gender Male ?older females(androgens)
11. Older age



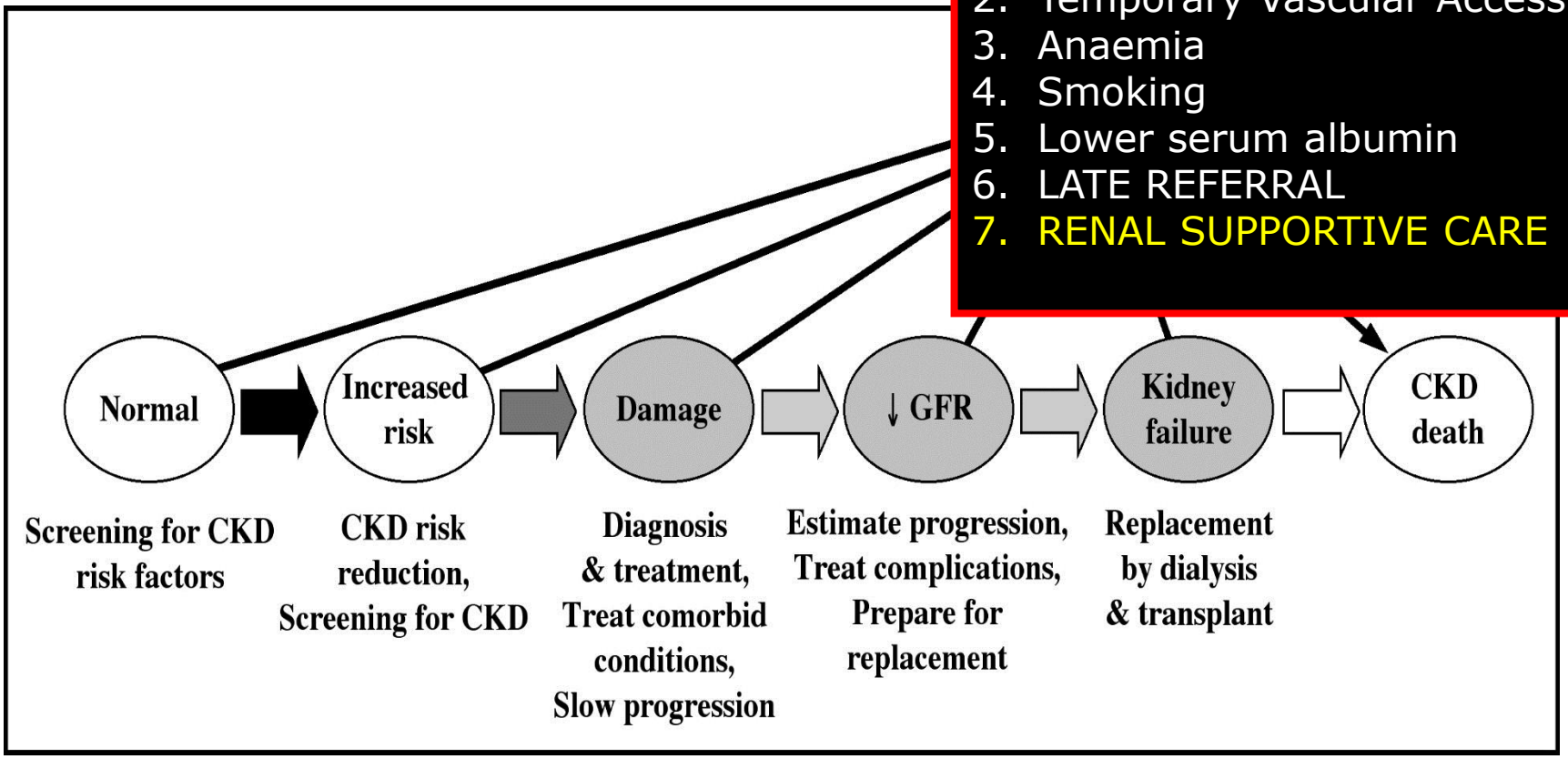
Tsai et al. Medicine
Volume 95, Number 11, March 2016

Levey et al. AJKD
2009-03-01, Volume 53, Issue 3, Pages S4-S16)

Progression Factors & CKD

End Stage Factors

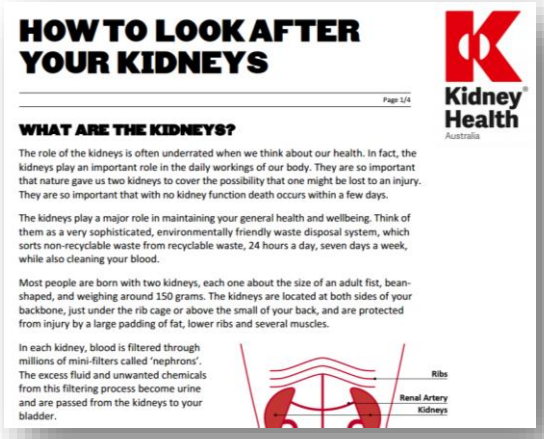
1. Lower dialysis Dose (kt/v)
2. Temporary Vascular Access
3. Anaemia
4. Smoking
5. Lower serum albumin
6. LATE REFERRAL
7. RENAL SUPPORTIVE CARE

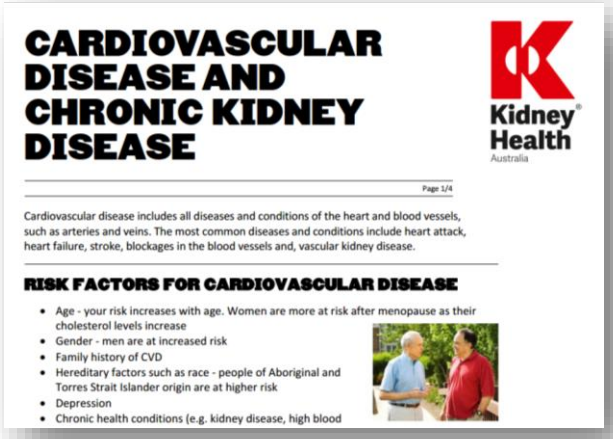


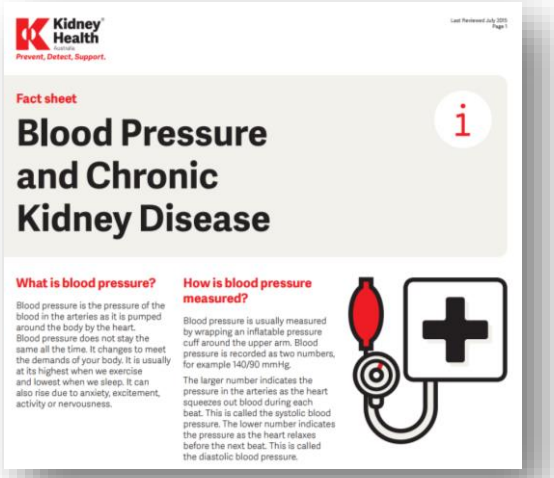
Levey et al. AJKD
2009-03-01, Volume 53, Issue 3, Pages S4-S16)

THANK YOU !

Available along with more kidney health fact sheets at www.kidney.org.au







Resources

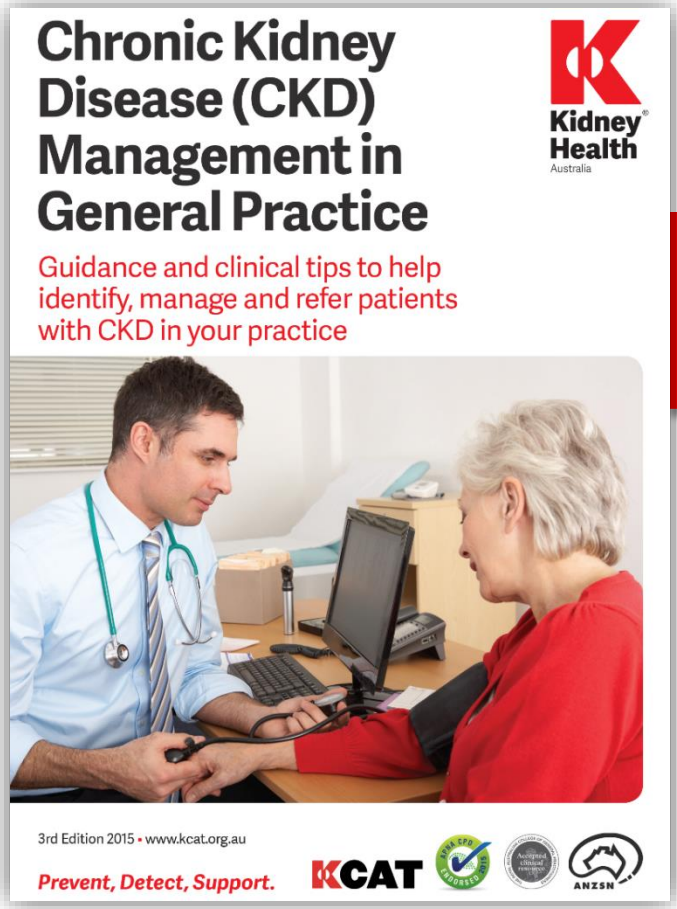
CKD patient fact sheets

Kidney Health Australia

Resources

CKD management in General Practice

2015 guidelines handbook



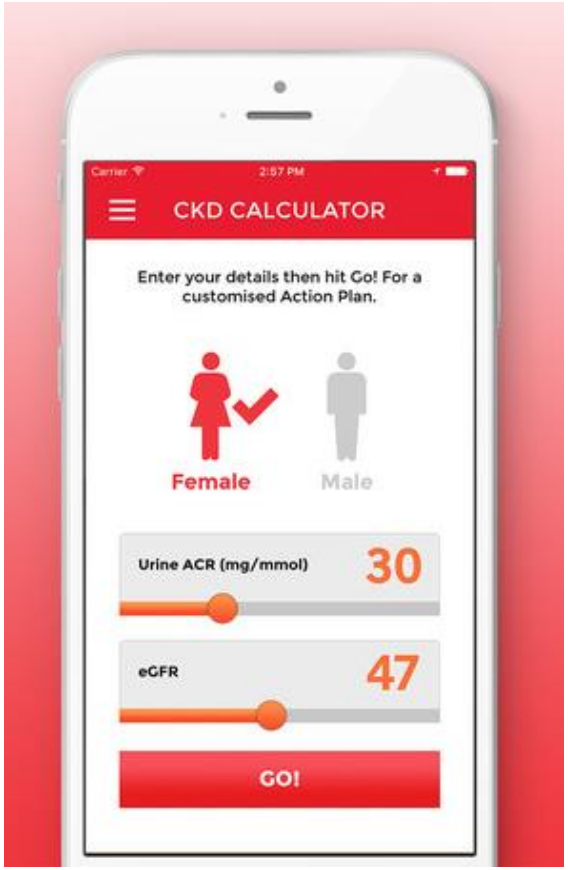
Available at

www.kidney.org.au/health-professionals

Kidney Health Australia

Resources

CKD-GO! Phone App



Rated a
'must have' App
by Medical
Observer

Available on
iTunes and Google
Play app stores

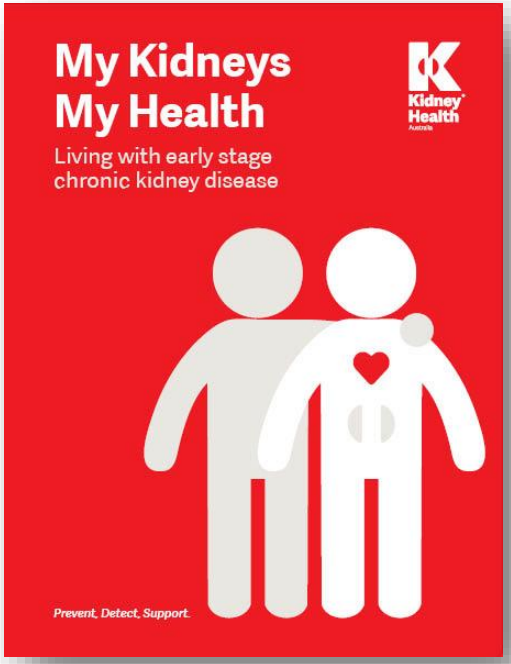
All the best bits of the
'CKD Management in General Practice' handbook
now in a handy app!

Kidney Health Australia

Resources

My Kidneys, My Health Handbook & App

Free resource for patients newly diagnosed with early stage CKD



App available on iTunes and Google Play app stores

Hardcopy books available to order visit **www.kidney.org.au**

Kidney Health Australia

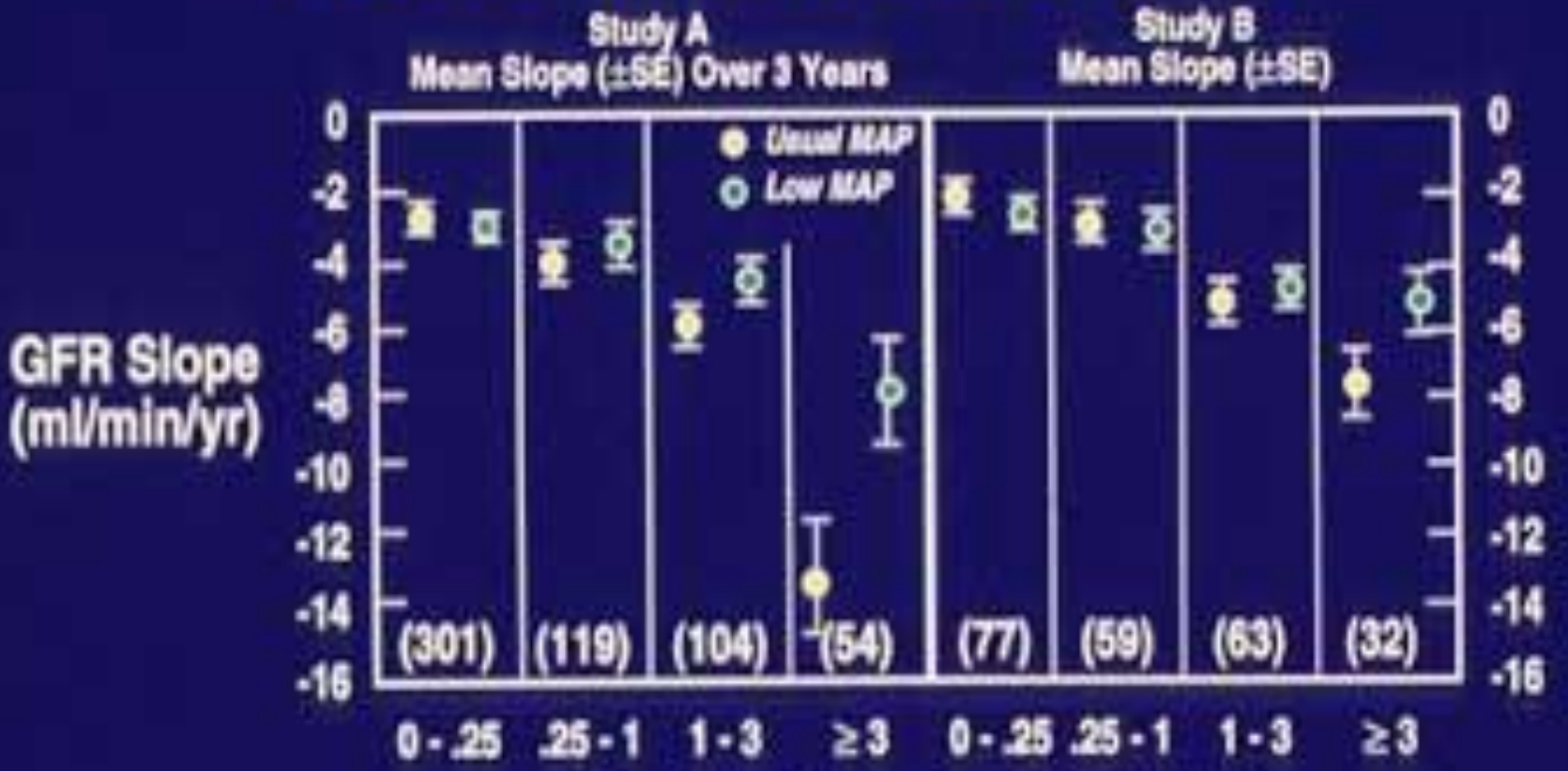
Kidney Community...

KIDNEY COMMUNITY members receive a monthly newsletter from KHA allowing you to access:

- Information and invitations to KHA's education and support activities
- Updates on medical research in kidney disease
- Information on advocacy opportunities and government relations issues
- Information on community and corporate events held by Kidney Health Australia

To join the kidney community, email community@kidney.org.au

BASELINE PROTEINURIA AND GFR SLOPE IN THE MDRD STUDY



Klahr, S, NEJM, 330:878, 1994