

eGFR and when to refer

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eGFR

- Background
- What is it?
- Why introduce it?
- How to use it?

eGFR-background

- GFR is the best overall estimate of kidney function
- Actual GFR measurements are not practical for widespread use
 - Inulin
 - ^{51}Cr -EDTA
 - Iohexol clearance
- Creatinine clearance-hassle+inaccuracies

So what is eGFR?

“e” is for estimated (but also erroneous!)

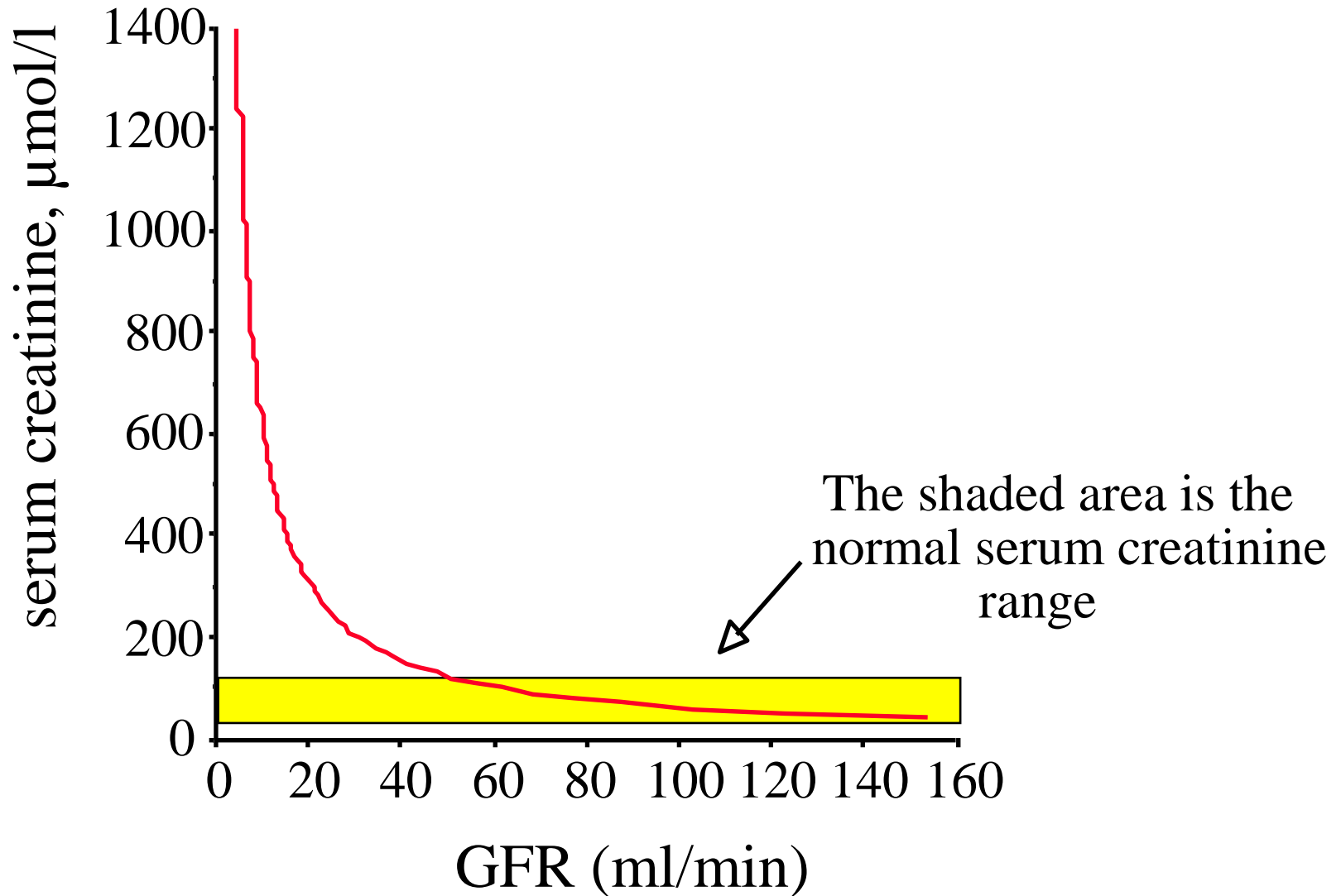
Equations based on serum creatinine but taking into account non-renal influences improve its relationship with GFR

- Various formulae - most common:
 - Cockcroft-Gault
 - MDRD

So what's wrong with creatinine?

- surrogate marker
 - alone *not* a good indicator of GFR
- level depends on :
 - GFR
 - muscle mass
 - quantity of meat eaten
 - hydration status
 - some drugs (e.g. trimethoprim & cimetidine, NSAID)

Relationship between GFR & creatinine



Why introduce eGFR?

- Creatinine levels alone are not good at indicating impaired function
- “abnormal” creatinine **not** necessary
- ~35% of end-stage renal failure patients present within 3mo. of needing dialysis
- About half of these have evidence of renal disease long before this-often “inappropriately” high creatinine

- **Cockcroft-Gault eGFR**

$$\text{♂} = \frac{1.23 \times (140 - \text{age}) \times \text{wt}(\text{kg})}{[\text{creatinine}, \mu\text{mol/L}]}$$

$$\text{♀} = \frac{1.05 \times (140 - \text{age}) \times \text{wt}(\text{kg})}{[\text{creatinine}, \mu\text{mol/L}]}$$

- **MDRD**

$$=186 \times (\text{creatinine}/88.4)^{-1.154} \times (\text{age})^{-0.203}$$

x 0.754 (if female)

x 1.210 (if black)

- No requirement for urea/albumin (or weight)
- 90% of subjects within 30% of true GFR

Answers

Martin Johnson

Calista Flockhart

CG formula

30mls/min

10mls/min

Renal NSF Part Two: Chronic Kidney Disease, Acute Renal Failure and End of Life Care (February 2005)

- Quality Requirement One: Prevention and Early Detection of CKD
- “Local health organisations can work with pathology services and networks to develop protocols for measuring kidney function by serum creatinine concentration together with a formula-based estimation of GFR, calculated and reported automatically by all clinical biochemistry laboratories”.

What is CKD?

- K/DOQI-NHANES III (1988-1994)

Stage	GFR(ml/min/1.73m ²)	Prevalence (US)
1	>90	3.3%
2	60-89	3.0%
3	30-59	4.3%
4	15-29	0.2%
5	<15 or dialysis	0.1%

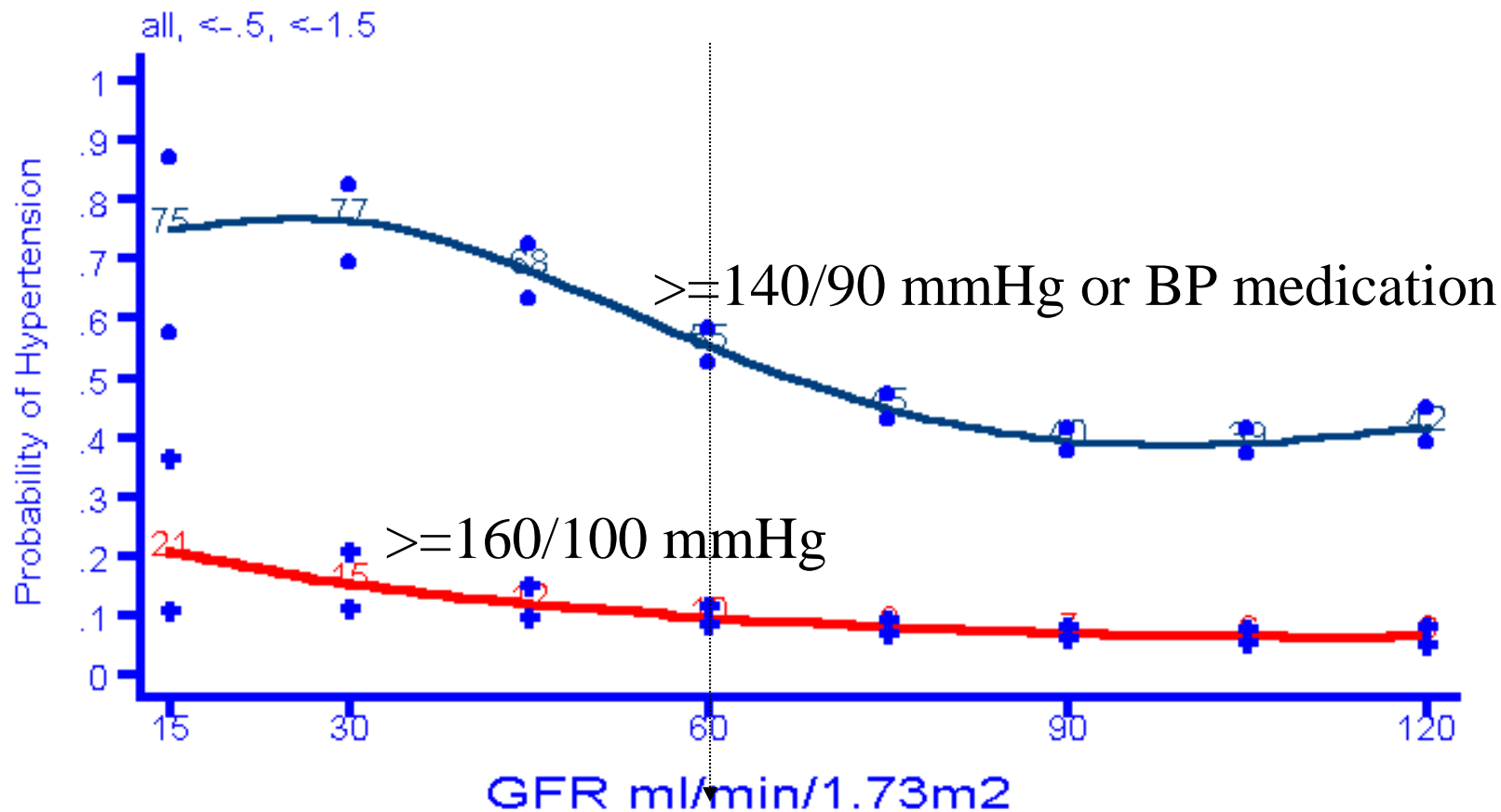
What is Chronic Renal Failure abbreviated to *CRF*?

Loss of renal function that is:

- Substantial (usually >50%)
- Clinically relevant
- Irreversible
- Progressive

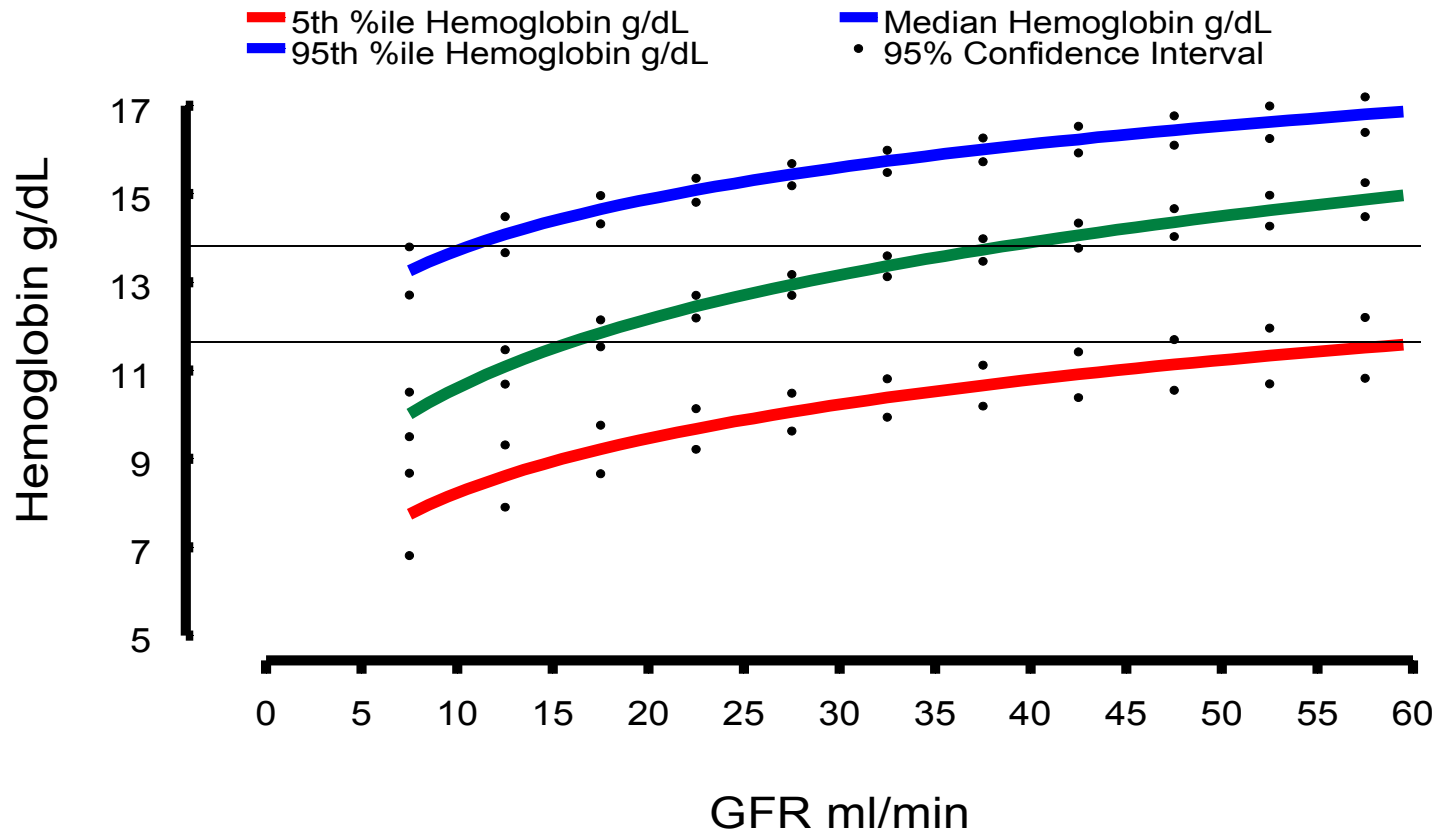
“SCIP”

Prevalence High Blood Pressure by Level of GFR in the NHANES III, Adults



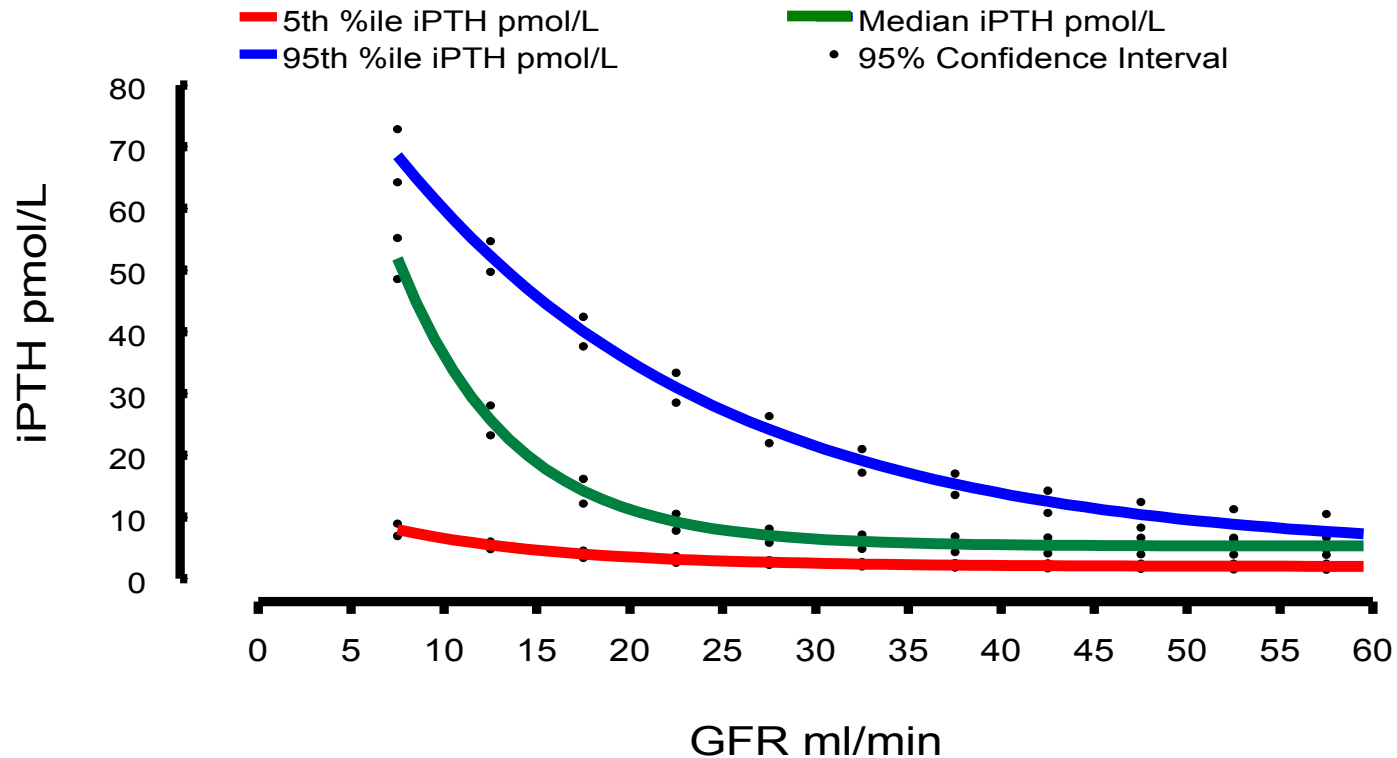
Hemoglobin Percentiles by GFR: Canadian Multicentre Cohort

Hemoglobin Percentiles by GFR



iPTH levels by GFR : Canadian Cohort

iPTH Percentiles by GFR



How does CRF present?

- end-stage renal failure with 'uraemic' symptoms
- hypertension
- asymptomatic haematuria/proteinuria
- incidental finding on blood chemistry
- screening e.g. APKD, reflux nephropathy

Problems with MDRD

- Only validated for patients with GFR <50 ml/min
- Not validated in Asian patients

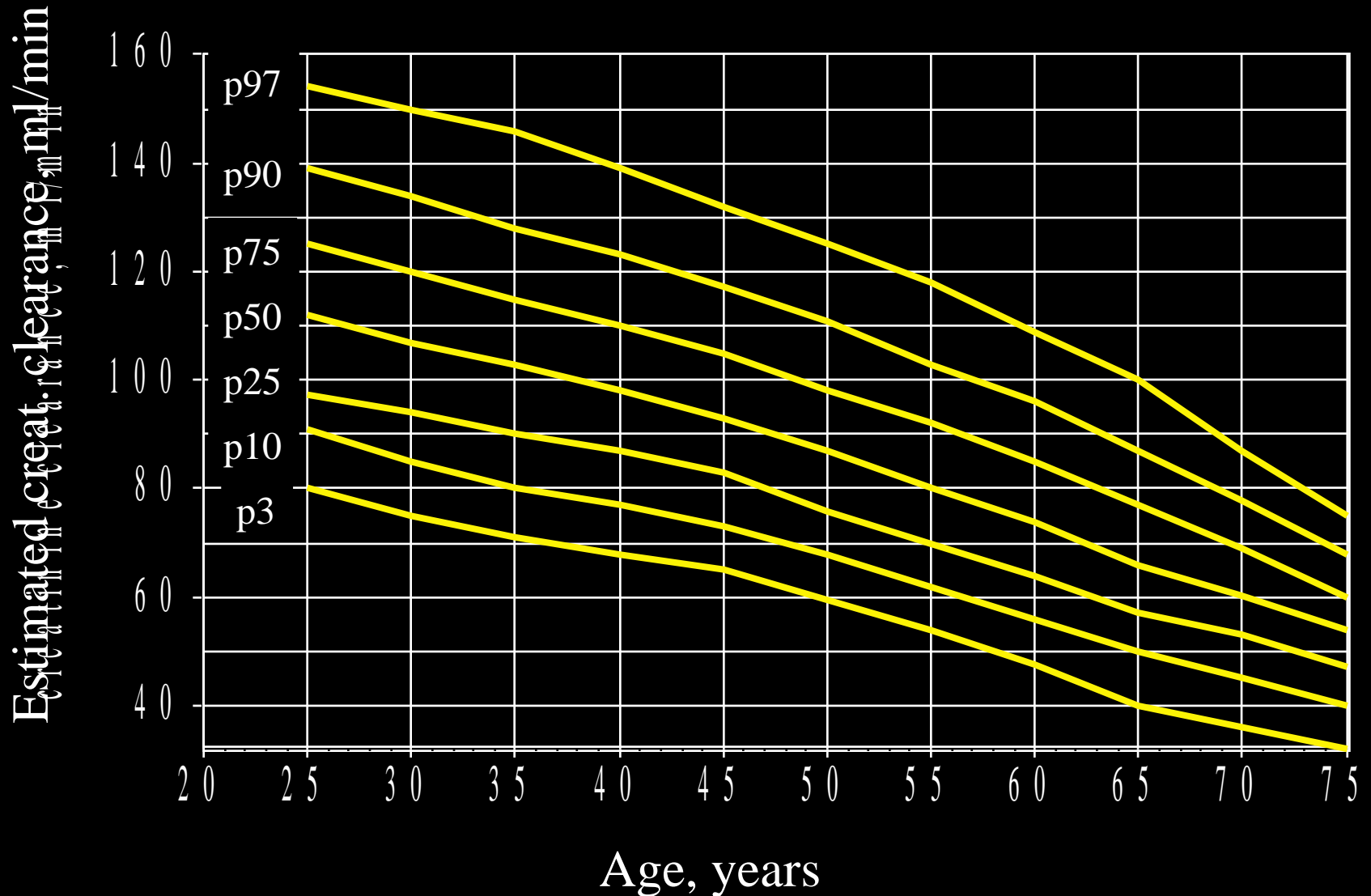
MDRD and level of GFR

	CKD	'healthy'
Rule et al 2004	-6.2%	-29%

Problems with the introduction MDRD eGFR reporting

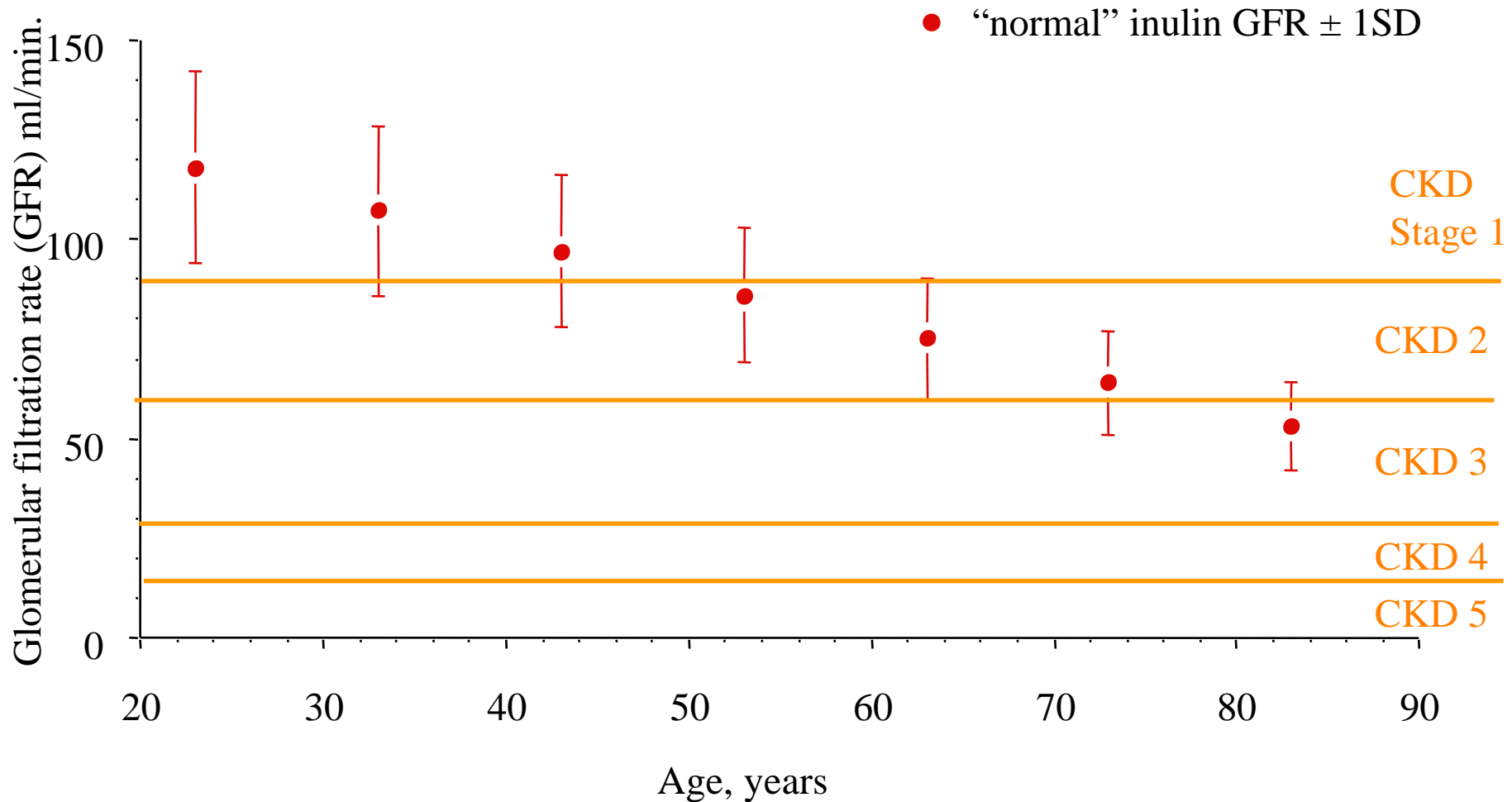
- Age related fall in GFR has not been taken into account
- Huge numbers of patients identified as CKD3

Creatinine clearance by age normal males



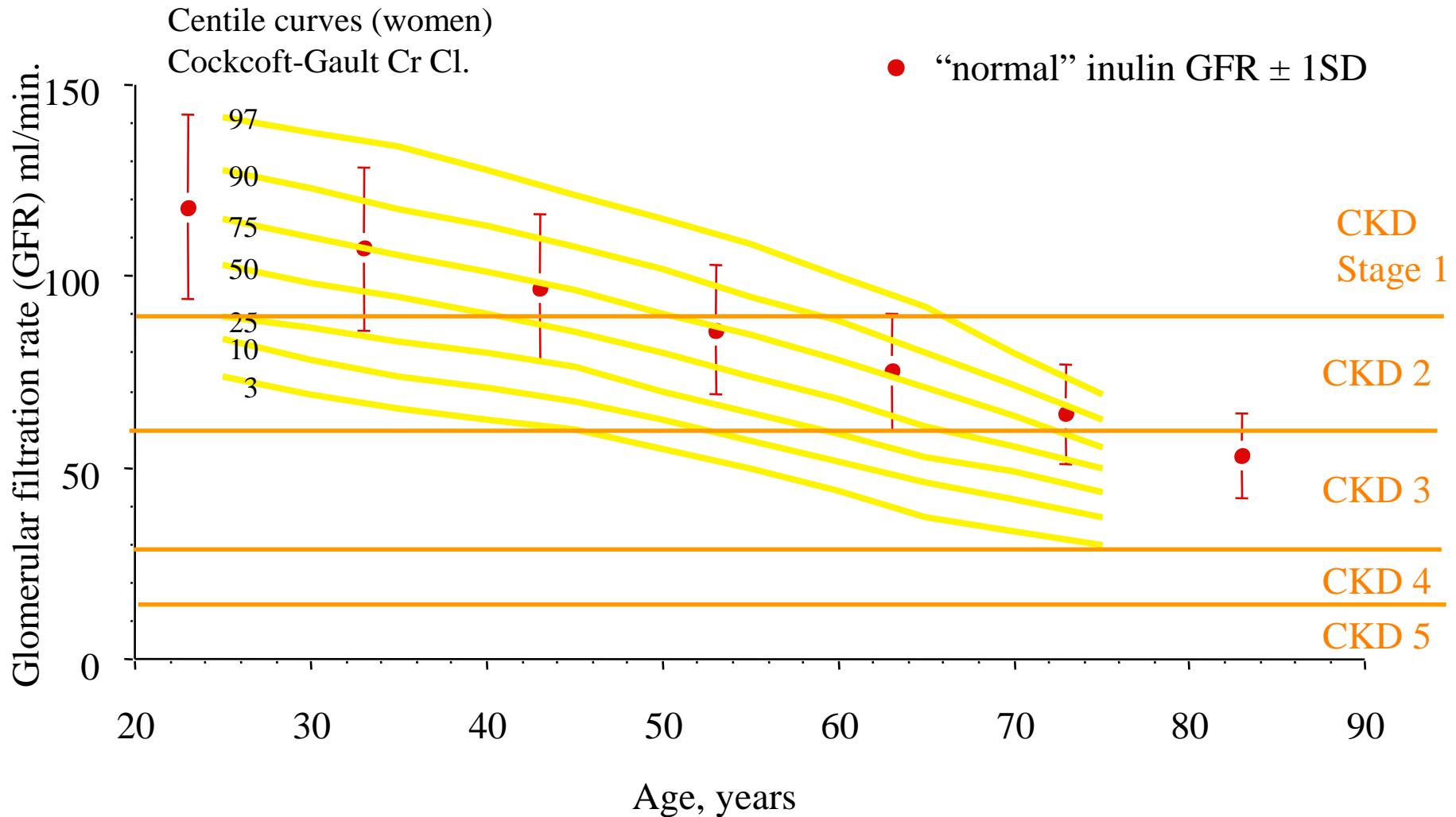
“Normal” inulin GFRs for women

Davies and Shock, 1950

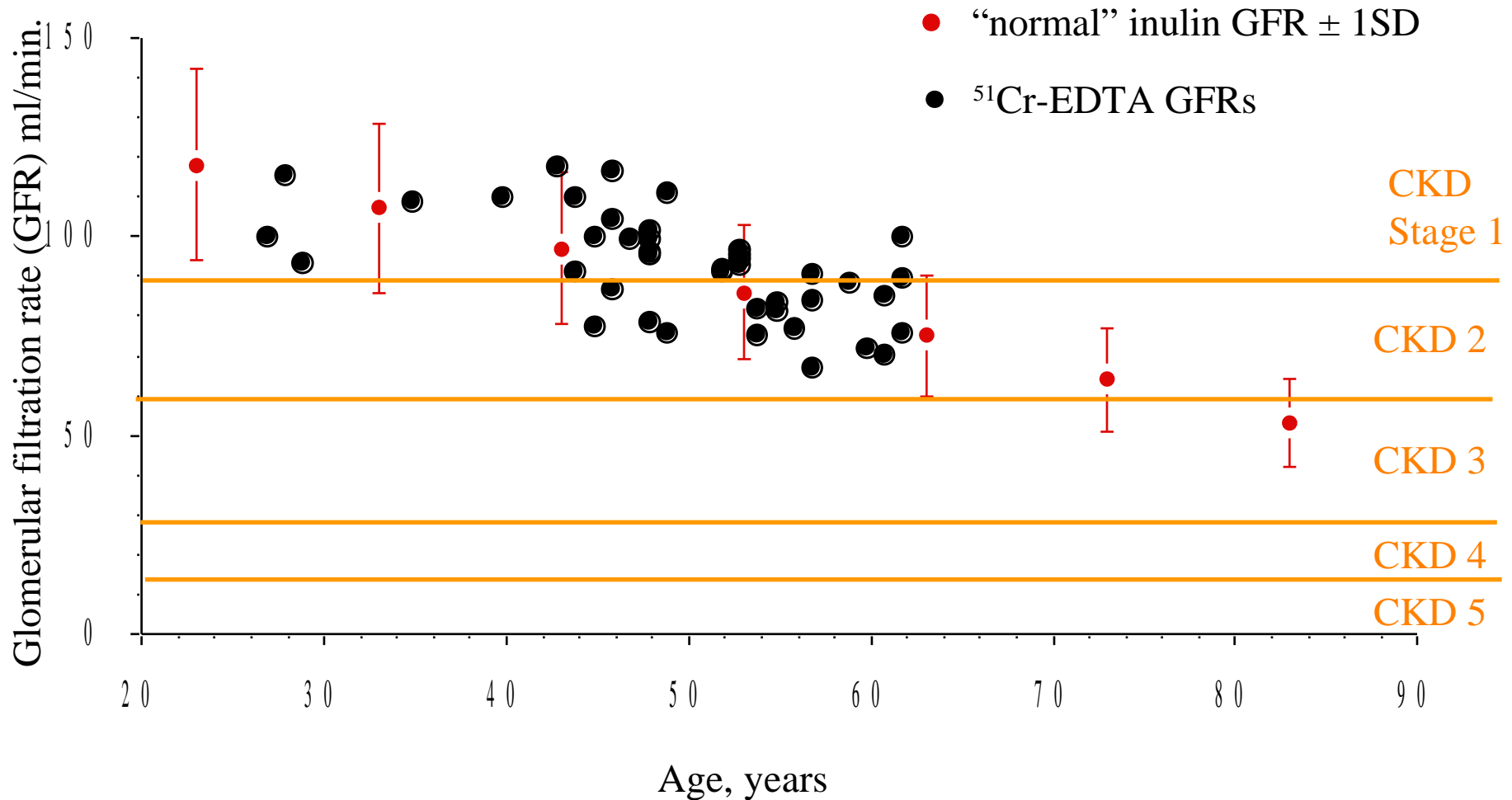


“Normal” inulin GFRs for women

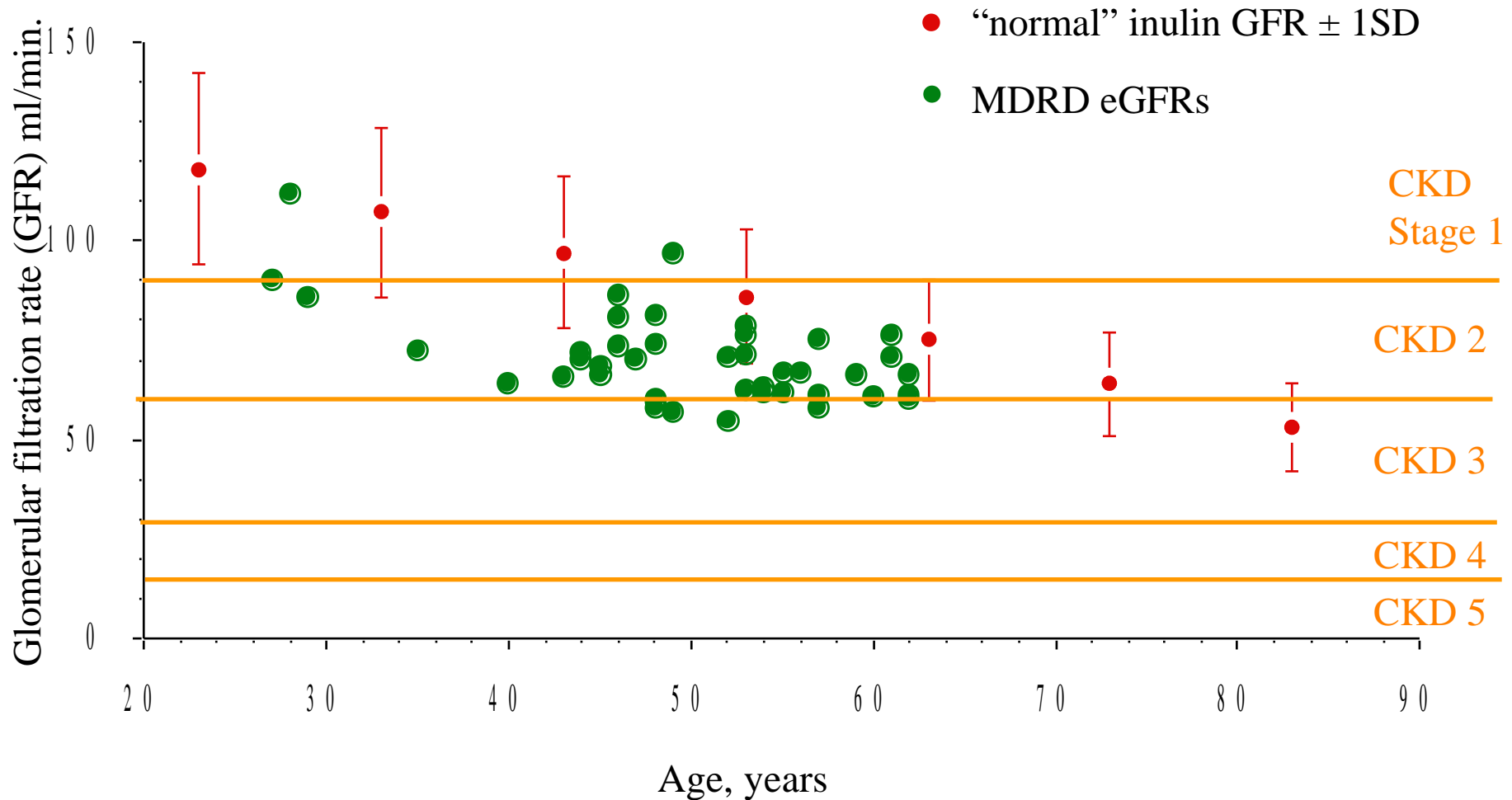
Davies and Shock, 1950



“Normal” inulin GFRs compared with ^{51}Cr -EDTA GFRs of OKU living kidney donors



“Normal” inulin GFRs compared with MDRD eGFRs of OKU living kidney donors



Oxford heretical advice

A GFR of “Stage 3” is not CKD unless

- $< 3^{\text{rd}}$ centile for age and gender
- Other evidence kidney disease
 - hypertension
 - proteinuria
 - haematuria
- eGFR is falling
- Patient has relevant other disease

The uncertainty of “CKD 3”

- eGFR < 60ml/min is difficult to interpret
- Likely to be abnormal in subjects <50y
- May be abnormal in older subjects
- May be associated with cardiovascular risk
- More likely to have markers of renal disease
- Keep an open mind but do not label as CKD unless <3rd centile for age and gender.

Centile chart (derived)

Centile	Age	40y	50y	60y	70y
50 th	M/F	95/85	85/75	70/65	65/55
10 th	M/F	75/65	65/60	55/50	45/40
3 rd	M/F	65/55	60/50	45/40	35/35

The patient with CKD

our Four Shared tasks

1. Diagnosis
especially treatable disease
2. Delay progression and avoid
exacerbants
3. Treat the complications
4. Plan for RRT

Survival with Dialysis/Transplantation

Age:	45-49yr	20-24yr	70-74yr
Gen pop:	33 (26-35)	56 (48-59)	13 (11-14)
Dialysis:	6.8 (6.2-10.1)	13.9 (13-22)	2.6 (2.5-3.5)
Txp:	21.9 (20-30)	36.2 (28-44)	7.9 (6.5-11)

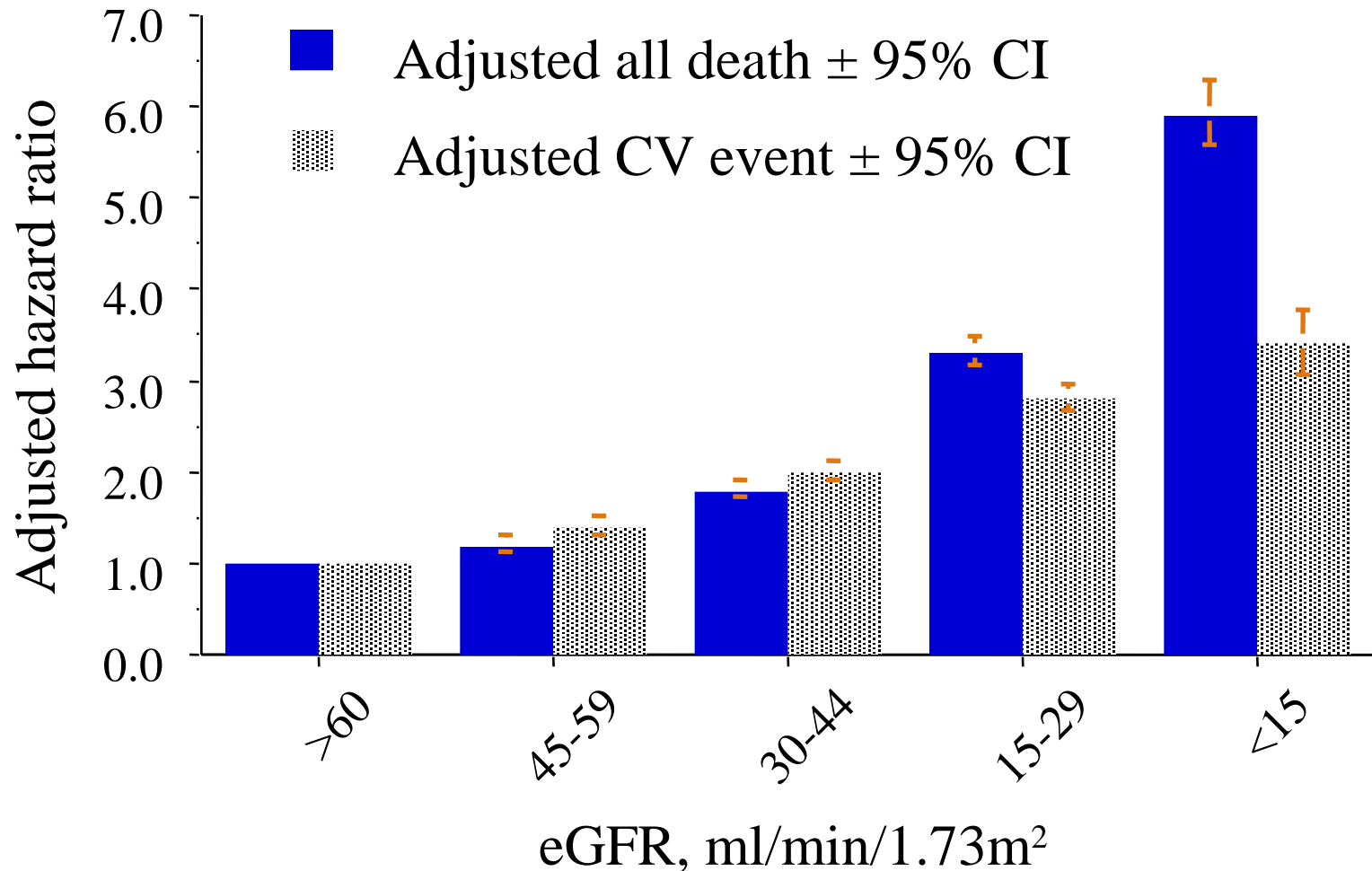
Colon Ca: 8.6 yr *Prostate Ca: 12.6 yr*

Mean life expectancy in years; ethnic range in brackets

Why is it important to identify patients with low GFR?

- Diagnosis-
 - Identifying patients with significant renal disease
- Treatment
- Managing chronic kidney disease (CKD)
- Recognition of increased cardiovascular morbidity associated with CKD

Relative risk of death and cardiovascular events increases with falling eGFR



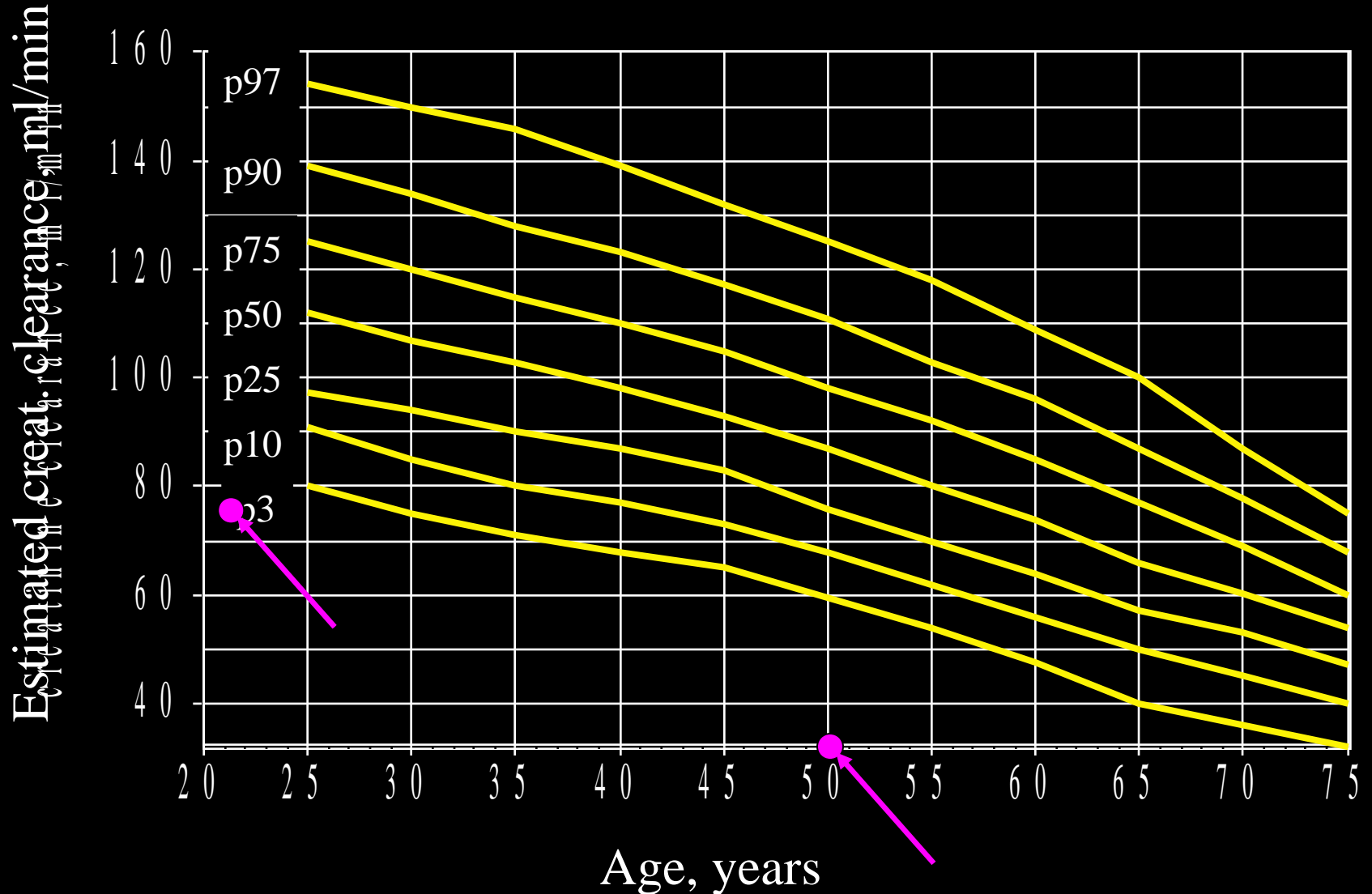
Case 1

- 50yr old woman, no significant PMH, creatinine 180 μ mol/L on 'routine' test. Examination unremarkable, BP 146/86mmHg, urine: Trace blood, 2+ protein
- What should be done?

Case 1: Management

- Estimated CrCl ~33ml/min
- (male 20yr, 90kg ~74ml/min)

Creatinine clearance by age normal males

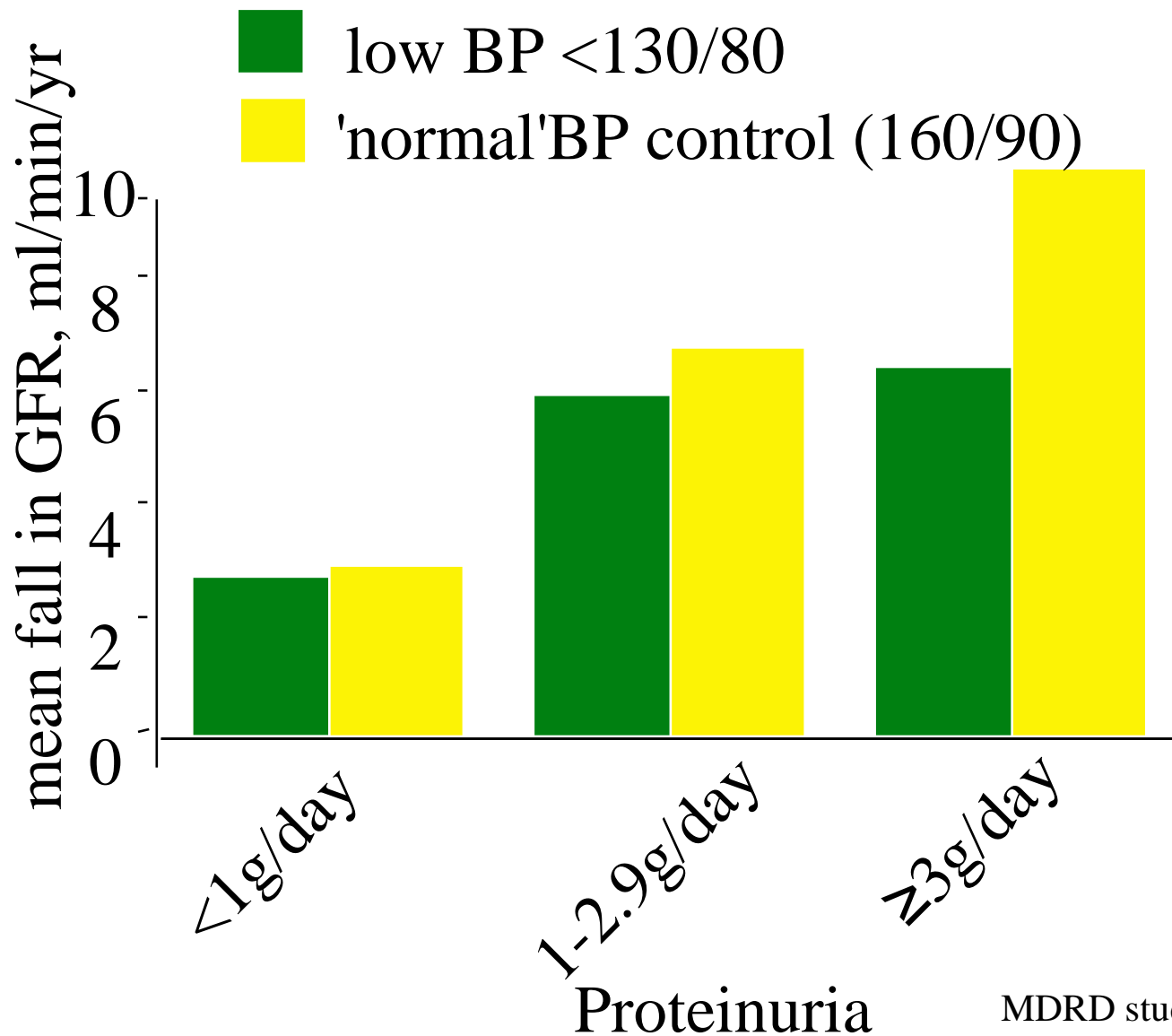


General measures to minimize rate of progression of CRF

- Hypertension
- Hypertension
- ?reducing proteinuria

- Other
 - Smoking
 - Cholesterol
 - **not** low protein diets

Effect of BP control on progression of CRF



Interpreting eGFR

What to do and when to refer

- Most patients with low eGFR don't progress
- Is the eGFR stable?.....look for historical creatinine levels
- Is there known (PMH) or co-lateral evidence of renal disease (proteinuria/haematuria)?

Interpreting eGFR

What to do and when to refer

- If significant CRF suspected *REFER*
- Consider renal ultrasound

Questions?