eGFR Has an "L" Now What?

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WNA Northwoods Clinical Practice Update

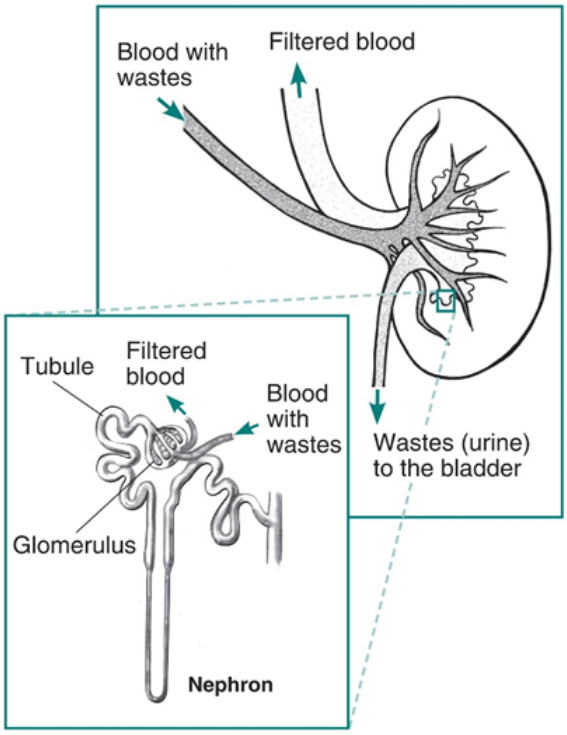
Marshfield Clinic Health System

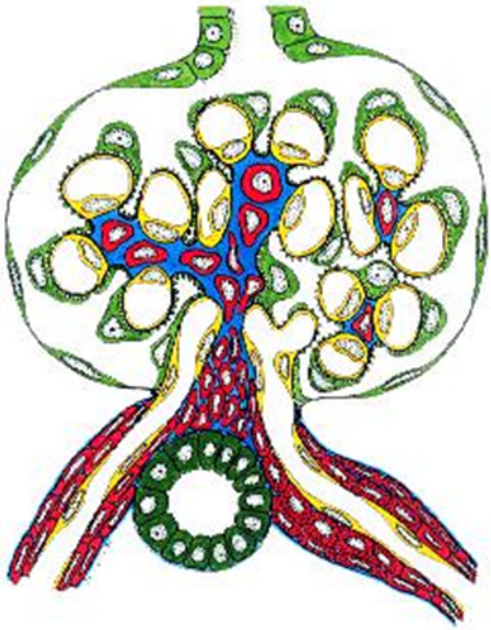
What is eGFR

- Glomerular Filtration Rate
  - How fast kidneys clean the blood
  - The "e" is for "estimated"

What's a Glomerulus

- Latin "glomus" meaning "ball of yarn."





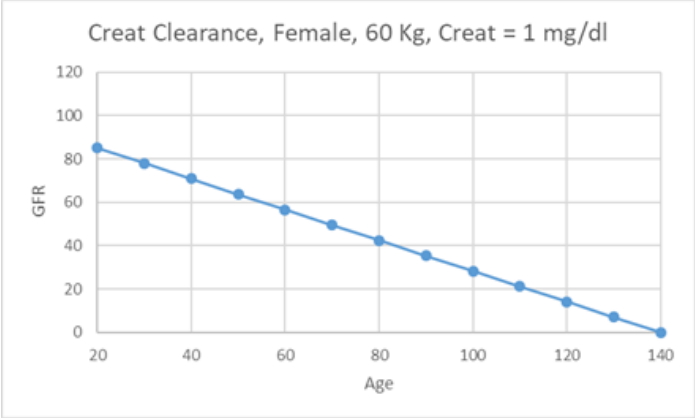
Glomeruli

- 1 million per kidney
- Where the blood is filtered
  - Normal 60 – 120 ml (2 – 4 oz.) of blood filtered per minute
- Challenging to directly measure filtration rate
  - Estimate is based on combination of lab and clinical variables, hence the "e" on eGFR

Estimating GFR

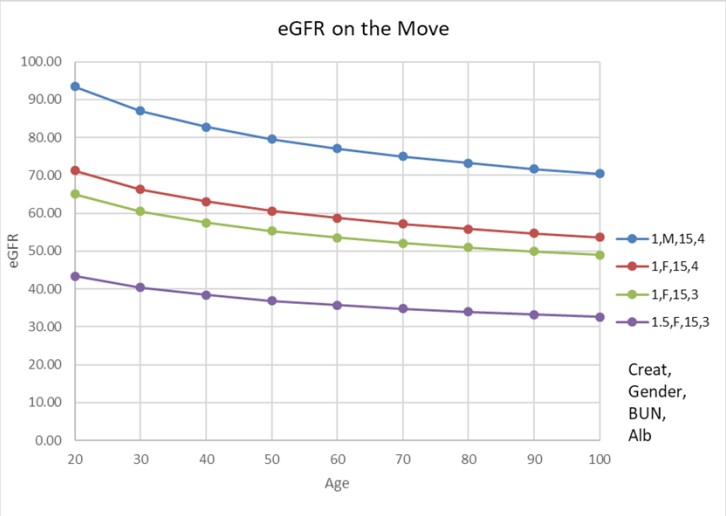
- Age
- Gender
- Creatinine
- Albumin
- Race
- BUN

Cockcroft – Gault (1976)
Creatinine Clearance =
(**140 – Age**) X (**Kg / 72**) X **(1 / Serum Creat**) X **0.85** if female



Modified Diet in Renal Disease (MDRD) Study

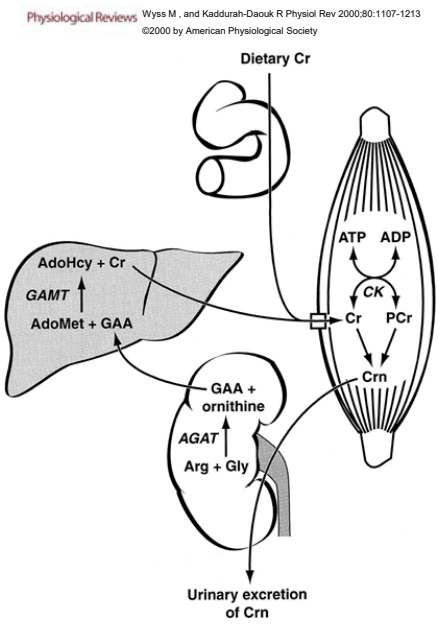
- 1990's study
- Assessed role of diet in changing course of kidney disease
- GFR measured with gold standard research method
- 1628 participants WITH KIDNEY DISEASE
  - Average creatinine was 2.3 mg/dl
  - "Young", average age = 50.6 years
  - Only 6% had diabetes
- This is the source of the data used to derive the eGFR equation

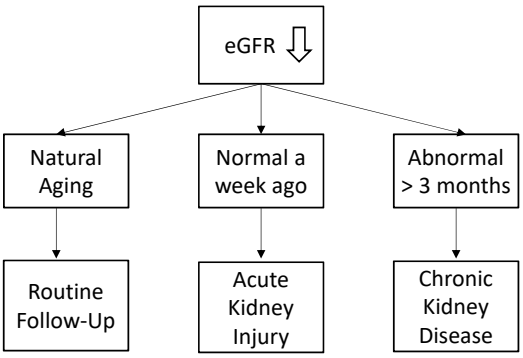


Estimating GFR - Creatinine

- Creatine is produced in the liver, converted to creatinine in muscles and excreted via glomerular filtration
- Factors that effect creatinine level
  - Muscle mass
  - Meat intake
  - Glomerular filtration
  - Tubular secretion
    - Blocked by trimethoprim and dronedarone

Major Routes Of Cr Metabolism In The Mammalian Body





Chronic Kidney Disease

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CKD is Very Quiet

Stages of Chronic Kidney Disease

Stage	Description	eGFR (ml/min/1.73 m^2)
I	Kidney Disease With NL GFR	≥ 90
II	Kidney Damage With Mild ⇓ GFR	60 – 89
III	Moderate ⇓ GFR	30 – 59
IV	Severe ⇓ GFR	15 – 29
V	Kidney Failure	< 15

Screening Based on Other Diseases

- Diabetes
- Hypertension
- Multiple myeloma
- Viral infections
  - HBV, HCV, HIV
- Chemotherapy
- Medications effecting GFR
  - ACE-I, ARB, NSAID
- Gastroesophageal Reflux
  - Use of PPI
- Nephrolithiasis
- Urinary obstruction
- Heavy metals
- Herbal supplements
- Family history of CKD
- Prior history of acute kidney injury
- Liver disease
- Autoimmune disease

Evaluation After the History and Physical

- Basic Metabolic Panel
- Urinalysis
- Urinary Protein/Creatinine
- Renal ultrasound
- Urine immunofixation
- CBC

Preservation of Renal Function

- Blood Pressure Control
  - Almost all CKD patients have hypertension
    - In the Chronic Renal Insufficiency Cohort study 28% of patient had masked hypertension
      - Need BP readings from outside the clinic
  - Break the vicious cycle
    - Renal damage ⇒ Secondary HTN ⇒ More Renal Damage ⇒ More HTN

Clin J Am Soc Nephrol 11:2016. doi: 10.2215/CJN.08530815

Goal BP

- KDIGO – Proteinuria > 500 mg/day
  - < 130/80
- JNC 8 – Pre-SPRINT
  - <140/90
- SPRINT
  - Systolic target 125 – 130
    - One of the inclusion criteria was GFR = 20 – 59
    - Exclusions: Proteinuria > 1 g/day, diabetes
- Make sure standing BP values obtained

Hypertension Treatment

- Diuretics and ACE I/ARB are the cornerstones of treatment of HTN in CKD
  - Class benefit of renal preservation of ACE I/ARB seen only in proteinuric patients
- Beta-blockers are the next class
  - Many of these patients have CAD
- All patients on treatment should have standing BP readings at each office visit

ACE I & ARB – Change in Creatinine

- This is good for renal preservation in that patient
  - Due to decreased single nephron GFR
  - That was the goal in starting the agent
- Not so good for prognosis overall
  - Increased risk of ESRD, CHF, MI, and death
- If creatinine goes up by more than 25% or continues to climb then further consideration warranted
  - Nephrology consult
  - Renal function is probably worse than initially suspected

ACE I & ARB - Hyperkalemia

- In patients with CKD, renal panel should be checked within a month of starting agent
- Rarely an indication to stop the agent
- Persistent [K] > 5.5 mEq/l or hospitalization for hyperkalemia are indications to discontinue
- Management: Diet, diuretics, sodium bicarbonate
  - Patiromer
    - $ 900 / month
  - Zirconium cyclosilicate
    - $ 750 / month

Hypertension - CCB

- Diltiazem and Verapamil
  - Evidence that may help slow progression of CKD
  - Beware of combining these agents with beta-blockers
- Dihydropyridines
  - Amlodipine, Nifedipine, etc.
  - 3rd or 4th agent

Nephrology Consultation

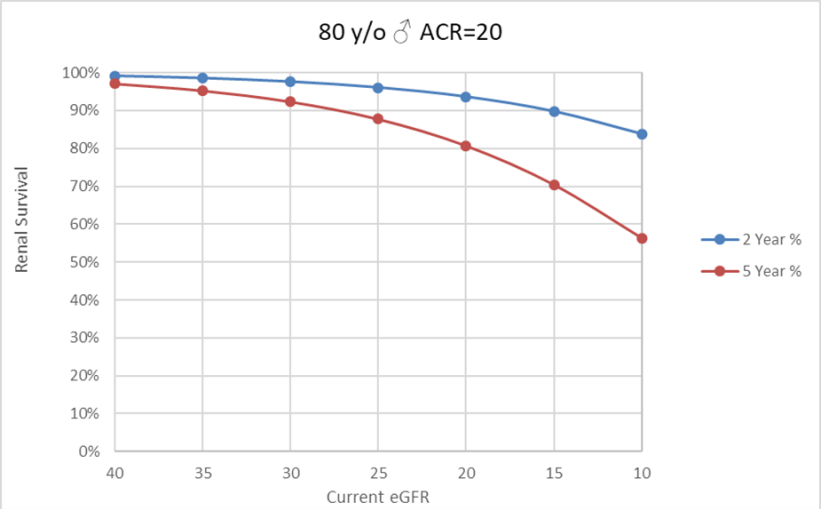
- Unsure of diagnosis
- eGFR < 30 ml/min
- Metabolic complications
- Unable to achieve BP targets
- Autoimmune glomerular disease

Predicting Probability of ESRD

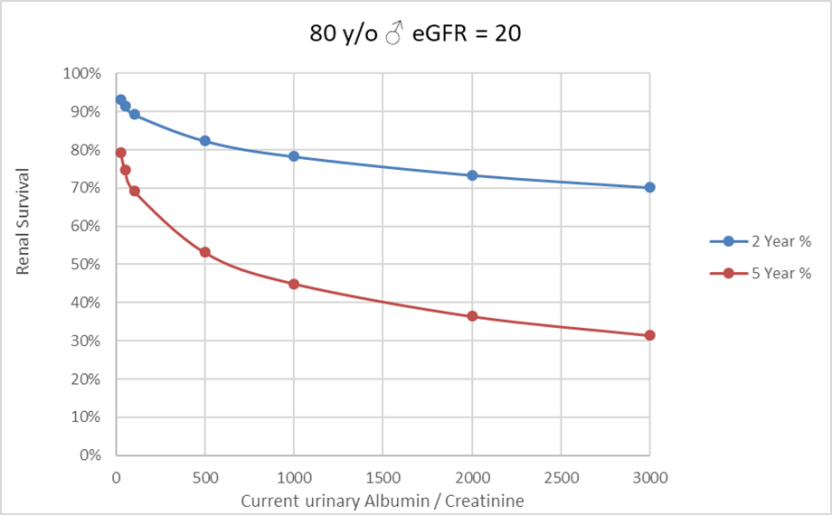
https://qxmd.com/calculate/calculator_125/kidney-failure-risk-equation-8-variable

- Variables
  - Gender
  - Age
  - eGFR
  - Urine Alb/Creat
  - Calcium
  - Bicarbonate
  - Phosphorous
  - Albumin

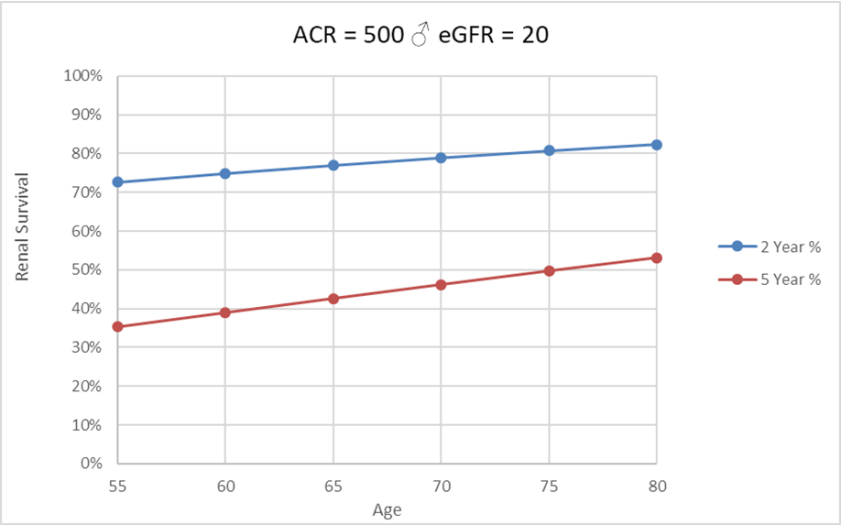
eGFR



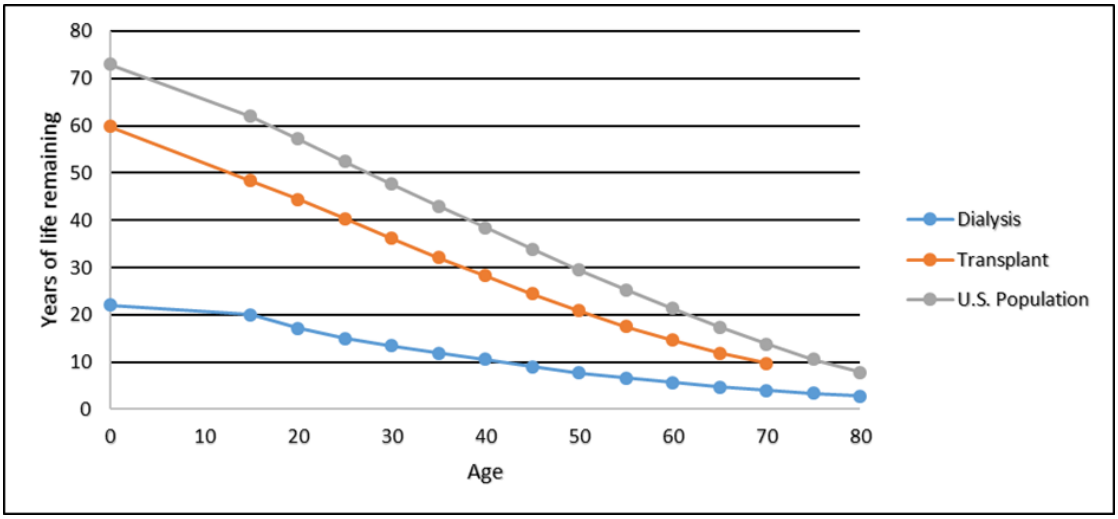
Urinary Alb / Creat



Age



Survival with ESRD



Patient #1

- 30 yr. old Caucasian male
- Appointment for DOT clearance
- Labs
  - Creat = 1.4 mg/dl, Alb = 4.0 g/dl, BUN = 20 mg/dl
- eGFR = 59.2 ml/min (L)

Adjusted mortality (deaths per 1,000 patient-years) by age, sex, treatment modality, and comorbidity among ESRD patients and the general Medicare population, 2015

Age	Sex	Dialysis	Transplant	All Medicare	Cancer	Diabetes	CHF	CVA/TIA	AMI
65-74	Male	**225**	65	28	72	41	111	74	90
	Female	**211**	54	18	65	30	97	58	100
75+	Male	**345**	129	88	131	106	223	156	182
	Female	**316**	111	81	131	99	221	148	187

Next Step

A. Nephrology Referral
B. Urinalysis
C. Diet history
D. Examine the patient
E. B,C, & D

Patient #2

- 85 yr. old Caucasian woman
- In for 6 month check, on chlorthalidone for hypertension
- BP = 138/74
- Labs
  - Creat = 1.0 mg/dl, Alb = 3.7 g/dl, BUN = 12 mg/dl
  - Urinalysis is normal
- eGFR = 55.9 ml/min (L)

Next Steps

A. Nephrology referral
B. Additional tests
   Anti-neutrophil cytoplasmic antibodies, ANA, Complements, Anti-GBM antibodies, Renal artery duplex
C. Inform her she will probably be on dialysis in a year or two
D. Wish her well and see back in 6 months on schedule

Acute Kidney Injury

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AKI - Categories

- Pre-Renal
- Vascular
- Glomerular Disease
- Tubular – Interstitial Disease
- Post-Renal - Obstruction

Testing

- Basic Metabolic Panel
- Phosphorous
- Magnesium
- Urinalysis
- Urinary Protein/Creatinine
- Renal ultrasound
- Urine immunofixation
- Urine Na if urine output < 500 ml/24 hours

Pre – Renal AKI

- Either actual or perceived volume depletion
- Actual
  - Volume depletion
- Perceived
  - Cardiorenal syndrome
  - ACE inhibition + NSAID
- Both
  - ACE inhibition + Volume depletion

Vascular

- Microscopic
  - Microangiopathic hemolytic anemia
    - Hemolytic uremic syndrome (E. coli and uncooked meat)
  - Atheroembolic disease
- Large vessel
  - Aortic dissection
  - Embolus

Glomerular Disease

- Urinalysis is the key
- Nephritic
  - Hematuria +/- RBC casts
  - Glomerular inflammation
- Nephrotic
  - Proteinuria predominates
  - Syndrome
    - >3 grams proteinuria, low albumin, edema, elevated cholesterol

Tubular - Interstitial

- Associated with systemic inflammation
  - Sepsis associated
- Allergic reaction
  - Drugs
    - PPI's
- Autoimmune disease

Post - Renal

- Cure AKI with a Foley catheter
- Prostate disease in men
- Gynecologic tumors in women

AKI Management

- Optimize volume
- Stop offending medications
- Place the Foley
- Nephrology consultation
  - Unsure of diagnosis
  - Glomerular disease
  - Metabolic complications

Patient #3

- 62 yr. old woman with diabetes and hypertension
  - Managed with chlorthalidone and lisinopril
  - Baseline BP = 134/78 & creatinine = 1.1 mg/dl
- 2 days of gastroenteritis, resolving
  - BP = 108/62
  - Recheck on labs:
    - Potassium = 5.4 mEq/l, Bicarbonate = 18 mEq/l
    - Creatinine = 2.4 mg/dl

Next Step

A. Admit to hospital for immediate dialysis
B. Stop chlorthalidone & lisinopril X 1 week
C. Oral rehydration with baking soda added
D. Renal ultrasound
E. Nephrology consult
F. B & C

Patient #4

- 85 yr. old man in for annual check due to wife's insistence
- Denies any problems
- Potassium = 5.2 mEq/l, Bicarbonate 19 mEq/l
- Creatinine = 4.0 mg/dl

Next Steps

A. Kidney biopsy
B. Admit for emergent dialysis
C. Urinalysis
D. Renal ultrasound
E. ANCA, ANA, Anti-GBM antibodies
F. C & D

Conclusions

- Decline in eGFR is a natural part of aging
- Most older patients with CKD will die before ESRD develops
- Majority of nephrology assessment is accomplished with a history, physical and a few labs

Remember to practice **complimentary** medicine…

Tell patient what they are doing right!

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