

Current Data and Recommendations for Staging Kidney Disease and Estimating GFR

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Disclosures

- I have no financial interests or relationships to disclose
- The views expressed in this material are those of my own [Dr. Tarra Faulk] and do not reflect the official policy or position of the U.S. Government, the Department of Defense, or the Department of the Air Force.

Educational Objectives



Discuss criteria for the diagnosis and staging of Chronic Kidney Disease (CKD)
Examine real-world practices for CKD screening and monitoring
Review the current recommendations for the assessment of kidney function
Describe methods for prognostication in both early and advanced CKD

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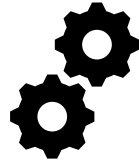
Describe methods for prognostication in both early and advanced CKD

Icon Legend

Know



Think about it



Further reading recommended





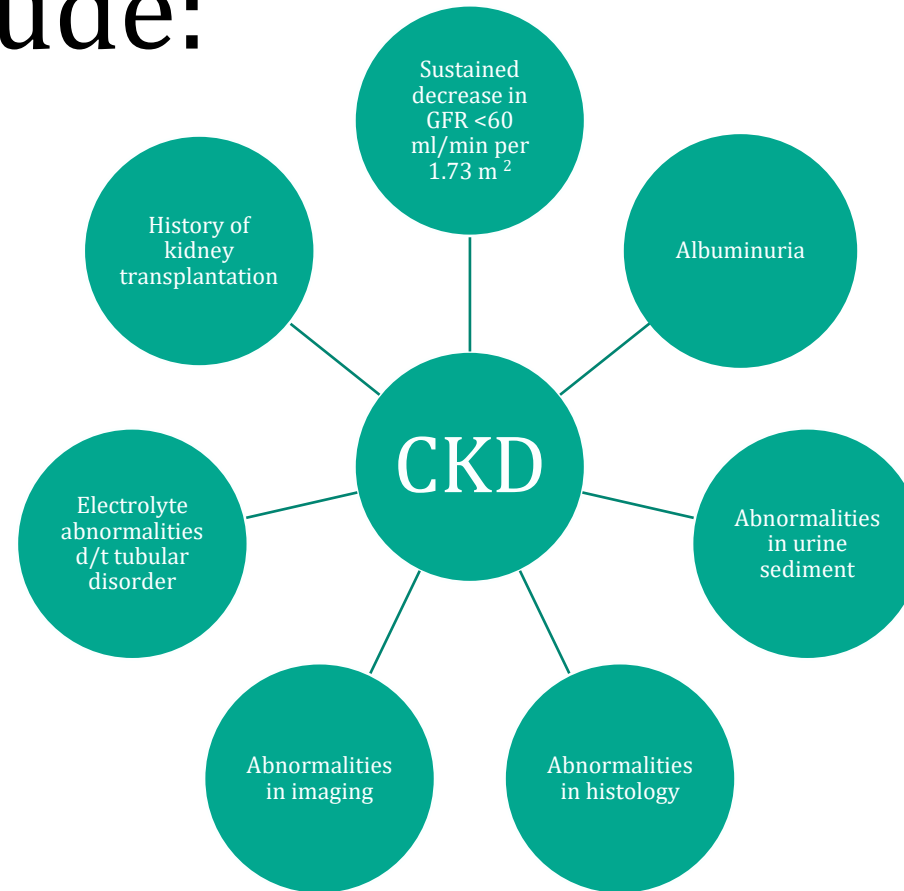
Definition of Chronic Kidney Disease

- Abnormalities of kidney structure or function, present for >3 months, with implications for health and is classified based on cause, GFR category, and albuminuria category (CGA)

KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease



Abnormalities of Kidney Structure or Function Include:



CKD Awareness

- Approximately 15% of the US adult population has CKD
- Most patients are asymptomatic until late stages of disease
- The vast majority of patients do not know they have CKD
 - Low CKD awareness
- Why?
 - Lack of provider driven education vs lack of screening?



CKD Screening- Why, Who & How?

- Why?
 - Many effective treatments exist to slow CKD progression and/or reduce CV risk
- Proposal- universal screening for persons with HTN, diabetes, and cardiovascular disease
- CKD screening must include assessment of eGFR AND albuminuria
 - Both strongly a/w increased risk of morbidity and mortality



CKD Screening- Real World Practices

- 523,165 adults with type 2 diabetes, over 1 year ¹
 - 51.6% tested for both urine ACR and eGFR (89.5% eGFR alone)
- 1,344,594 adults with diabetes ²
 - 35% tested for both urine ACR and eGFR
- 2,334,461 adults with HTN (no diabetes) ²
 - 4%

¹ Stempniewicz, et.al. Diabetes Care 44: 200-2009, 2021

² Shin, et.al. Hypertension 78: 1042-1052, 2021

CKD Screening- Why & How?



- Proposal- universal screening for persons with HTN, diabetes, and cardiovascular disease
- CKD screening must include assessment of eGFR and albuminuria
 - Both strongly a/w incr risk of morbidity and mortality
- **Why?**
 - Many effective treatments exist to slow CKD progression and/or reduce CV risk
 - Adherence to guideline-recommended therapy

- Lifestyle modification
- Blood pressure and glycemic control
- RAAS inhibition
- Statin therapy
- Sodium-glucose cotransporter-2 inhibitors
- Nephrotoxin avoidance
- Others – targeted therapies



Cause

- Clinical Suspicion/Presumption
- Biomarkers
- Genetic Testing
- Imaging
- Renal Biopsy

Estimated Glomerular Filtration Rate (eGFR)

- Summary of Recommendations (2012, 2021) ^{1,2}



- Adoption of new CKD-EPI estimating equation based on creatinine and refit without the race variable

- Result: increase the prevalence of CKD among Black individuals and decrease the prevalence among non-Black individuals



- Expand the use of cystatin C

- Equations using both creatinine and cystatin C are more accurate than the singular use of either

- Therefore, change from CKD-Epi 2009 to CKD-Epi 2021 equation

¹ Delgado, et.al. J Am Soc Nephrol 32: 2994-3015, 2021

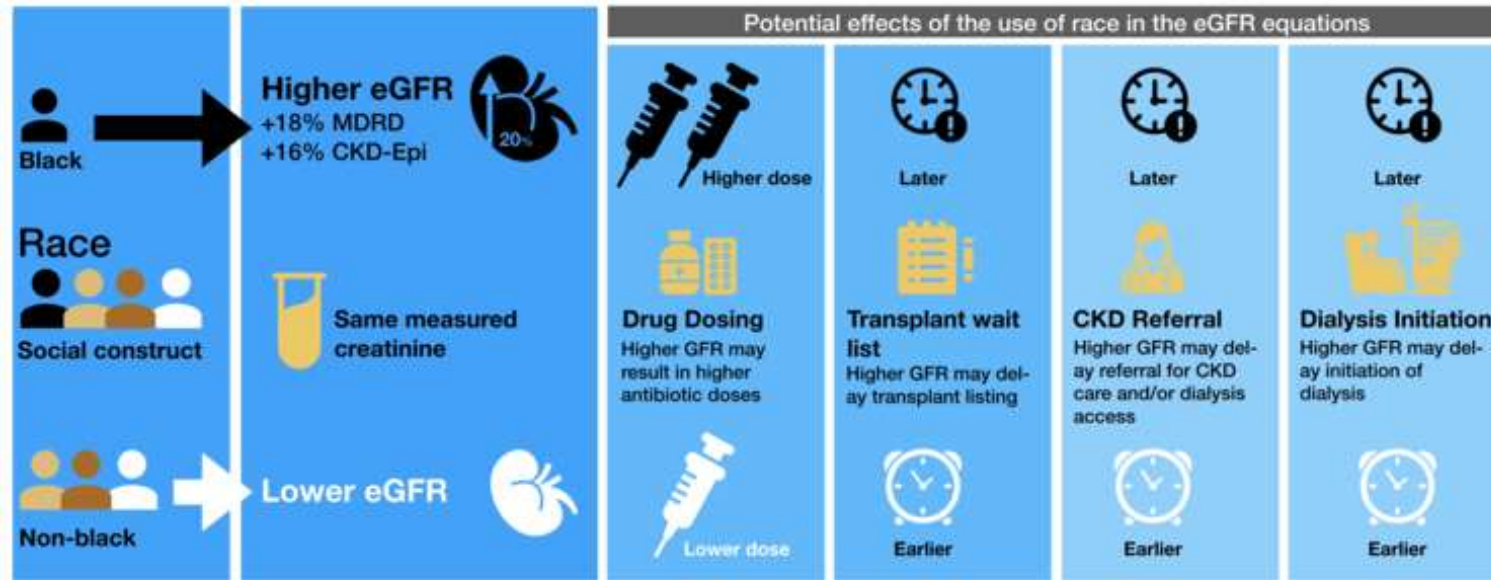
² Inker, et.al. N Eng J Med 385: 1737-1749, 2021



Do Current eGFR Equations Disadvantage Black Patients?

Do the current eGFR equations disadvantage the black patients?

Eneanya ND, Yang W, Reese PP. Reconsidering the Consequences of Using Race to Estimate Kidney Function. *JAMA* 322 Number 2, July 9, 2019.

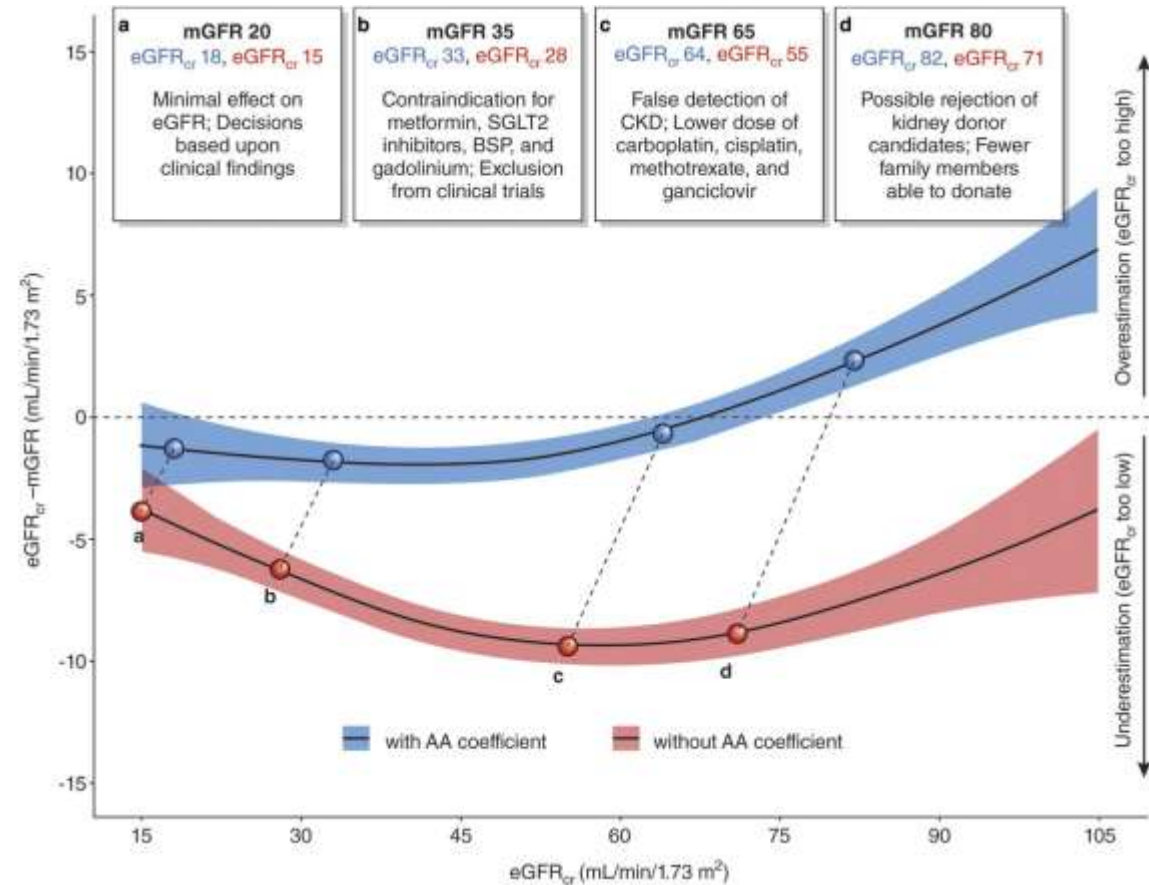


Visual Abstract by Krithika Mohan (@krithicism), NSMC Intern 2019

Krithika Mohan (@krithicism)



Clinical Decisions Affected by Accuracy of GFR



Levey. CJASN August 2020, 15 (8) 1203-1212

Albuminuria Estimation

- Why albuminuria?

- Along with eGFR has been strongly associated with incr. risk of morbidity and mortality ^{1,2,3}



Goal- 24-hour albuminuria or first morning urine ACR (ACR, not PCR)

¹ Levey, et.al. Kidney Int 80: 17-28, 2011

² Koye, et.al. Am J Kidney Dis 72: 653-661, 2018

³ Halbesma, et.al. J Am Soc Nephrol 17: 2582-2590, 2006



Classification of CKD

Prognosis of CKD by GFR and albuminuria category

Prognosis of CKD by GFR and Albuminuria Categories: KDIGO 2012

				Persistent albuminuria categories Description and range		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30-300 mg/g 3-30 mg/mmol	>300 mg/g >30 mg/mmol
GFR categories (ml/min/1.73 m ²) Description and range	G1	Normal or high	≥90	Green	Yellow	Orange
	G2	Mildly decreased	60-89	Green	Yellow	Orange
	G3a	Mildly to moderately decreased	45-59	Yellow	Orange	Red
	G3b	Moderately to severely decreased	30-44	Orange	Red	Red
	G4	Severely decreased	15-29	Red	Red	Red
	G5	Kidney failure	<15	Red	Red	Red

Green: low risk (if no other markers of kidney disease, no CKD); Yellow: moderately increased risk; Orange: high risk; Red, very high risk.

KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease

Clinically Speaking...

- 48/F with CKD G4A1 of unknown etiology but with h/o DM, HTN, and family history of multiple persons on dialysis
- 55/M with CKD G3A2 presumed 2/2 Diabetic Nephropathy
- 35/M with CKD G2A2 2/2 biopsied IgA Nephropathy

Prognostication

- Kidney biopsy findings
- Risk prediction equations

**Table 1. Risk tools in CKD**

Tool	Study Population	Variables	Outcome	Time Frame	Weblink
4-variable KFRE ³²	eGFR <60 ml/min per 1.73 m ²	Age, sex, eGFR, urine ACR	Kidney failure	2 and 5 years	kidneyfailurerisk.com
8-variable KFRE ²⁴	eGFR <60 ml/min per 1.73 m ²	Age, sex, eGFR, urine ACR, serum albumin, phosphate, bicarbonate, corrected calcium	Kidney failure	2 and 5 years	kidneyfailurerisk.com
Advanced CKD ³³	eGFR <30 ml/min per 1.73 m ²	Age, sex, race, eGFR, urine ACR, systolic blood pressure, history of cardiovascular disease, diabetes, smoking history	Kidney failure, cardiovascular disease, death	2 and 4 years	ckdpcrisk.org/lowgfrevents
Incident CKD ³⁴	eGFR >60 ml/min per 1.73 m ²	Age, sex, race, eGFR, urine ACR (optional if no diabetes), history of cardiovascular disease, body mass index, smoking history, hypertension, diabetes, diabetes medications and hemoglobin A1c (if diabetes)	Incident eGFR <60 ml/min per 1.73 m ²	5 years	ckdpcrisk.org/ckdrisk
PCR to ACR ²⁵	Urine PCR >50 mg/g	Urine PCR or urine dipstick, (sex, hypertension, diabetes optional)	Urine ACR	NA	ckdpcrisk.org/pcr2acr

KFRE, kidney failure risk equation; ACR, albumin-creatinine ratio; PCR, protein-creatinine ratio.

Nephrology Self-Assessment Program- Vol 21, No2, June 2022

eGFR Calculator

The screenshot shows the top navigation bar of the National Kidney Foundation website. It includes the logo, a search bar with a 'Login' button, and a 'Donate' button. Below the navigation bar is a horizontal menu with links for 'Kidney Basics', 'Treatment & Support', 'Transplantation', 'Kidney Professionals', 'Research', and 'Get Involved'. The main heading is 'eGFR Calculator'. Below the heading is a paragraph explaining that Glomerular filtration rate (GFR) is the best overall index of kidney function and that the National Kidney Foundation recommends using the CKD-EPI Creatinine Equation (2021) to estimate GFR. A link is provided for more information. Below this is another paragraph stating that NKF and the American Society of Nephrology have convened a Task Force to focus on the use of race to estimate GFR, with a link to read more about the task force. The input fields are: Serum Creatinine: 1.9 (with units mg/dL and μmol/L), Serum Cystatin C: 0.7 (with unit mg/L), and Age: 39 (with unit Years). A 'Calculate' button is visible at the bottom right of the input section.

The screenshot shows the results section of the eGFR Calculator. It includes a link for 'FAQs About GFR Estimates'. The results are displayed in a table-like format with three rows, each showing the equation used, the calculated value, and the units. The first row is 'CKD-EPI creatinine equation (2021)' with a value of .45 and units mL/min/1.73m². The second row is 'CKD-EPI creatinine-cystatin equation (2021)' with a value of .81 and units mL/min/1.73m². The third row is 'CKD-EPI cystatin C equation (2012)' with a value of 122 and units mL/min/1.73m². Below the results is a note: 'For persons under 18 years of age, use the pediatric GFR calculator.' At the bottom, there is a section titled 'Is it CKD?' with a list of links for further information.

https://www.kidney.org/professionals/kdoqi/gfr_calculator

eGFR Calculator

Is it CKD?

Either of the following must be present for ≥3 months to be CKD:

- GFR less than 60 ≥3 months
- ACR ≥30 mg/g or other markers of kidney damage

Click to learn more.

Equation used to estimate GFR?

- CKD-EPI Creatinine (2021)
- CKD-EPI Creatinine-Cystatin C (2021)
- CKD-EPI Cystatin C (2012)

What is the patient's ACR?*

- <30 mg/g
- <3 mg/mmol
- 30-300 mg/g
- 3-30 mg/mmol
- >300 mg/g
- >30 mg/mmol

Based on the information supplied:

GFR category is:†

ACR category is:**

CKD classification is:

Risk of progression is:

- CKD-EPI Creatinine (2021)
- CKD-EPI Creatinine-Cystatin C (2021)
- CKD-EPI Cystatin C (2012)

What is the patient's ACR?*

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Based on the information supplied:

GFR category is:†

ACR category is:**

CKD classification is:

Risk of progression is:

Frequency of monitoring should be:

Referral to a nephrologist is:

* Neither the category of GFR nor the category of albuminuria alone can fully capture prognosis of CKD. Persistent and increased albuminuria has been shown to be an independent risk factor for CKD progression.

https://www.kidney.org/professionals/kdoqi/gfr_calculator

eGFR Calculator

Referral to a nephrologist is:

* Neither the category of GFR nor the category of albuminuria alone can fully capture prognosis of CKD. Persistent and increased albuminuria has been shown to be an independent risk factor for CKD progression.

** In the absence of evidence of kidney damage, neither GFR category G1 nor G2 fulfill the criteria for CKD.

*** ACR 30-300 mg/g for > 3 months indicates CKD.

Additional Information

Formulas

- [CKD-EPI Creatinine Equation \(2021\)](#)
- [CKD-EPI Creatinine-Cystatin Equation \(2021\)](#)
- [CKD-EPI Cystatin C Equation \(2012\)](#)
- [MDRD Study Equation](#)
- [Learn more about CKD-EPI Collaboration and estimating GFR at \[www.ckdep.org\]\(http://www.ckdep.org\)](#)

About CKD

- [Criteria for CKD?](#)
- [Classification of CKD?](#)
- [Why classify CKD?](#)
- [Explore Case Studies](#)

[CKD Risk Map](#)

[Clinician Tools](#)

[Kidney Failure Risk Equation](#)

[Publications](#)

https://www.kidney.org/professionals/kdoqi/gfr_calculator

eGFR Calculator

CKD-EPI Equations for Glomerular Filtration Rate (GFR)

Estimates GFR based on serum creatinine, serum cystatin C, or both

IMPORTANT

The 2021 CKD-EPI equation is now the recommended standard. This version does not include race, as do the 2009 and 2012 CKD-EPI creatinine and creatinine-cystatin C equations. See here for more on our approach to addressing race and bias on MDCalc.

With the 2021 equation, for the same creatinine value, the 2021 equation will estimate a lower GFR for Black patients and a higher GFR for non-Black patients.

INSTRUCTIONS

For use in patients with stable kidney function. While the combined creatinine and cystatin C equation can add accuracy, cystatin C is not available in all laboratories and the creatinine-based equation is adequate for many clinical purposes.

2021 CKD-EPI creatinine is currently recommended by the ASN and NKF for GFR reporting in the United States.

When to Use

Pitfalls

Why Use

About the Creator



Dr. Andrew S. Levey



Dr. Lesley A. Inker



The CKD Epidemiology Collaboration (CKD-EPI)

Also from MDCalc...

Related Calculators

- MDRD GFR Equation
- Kidney Failure Risk Calculator
- Kinetic Estimated Glomerular Filtration Rate (keGFR)

Content Contributors

- Dr. Ari Aziz, MD
- Evan Zeitler, MD

Equation

2021 CKD-EPI Creatinine

2021 CKD-EPI Creatinine-Cystatin C

2009 CKD-EPI Creatinine

2012 CKD-EPI Cystatin C

2012 CKD-EPI Creatinine-Cystatin C

Sex

Female

Male

Age

years

Serum creatinine

Norm: 0.7 - 1.3

mg/dL

Serum cystatin C

Norm: 0.51 - 0.98

mg/L

Result:

Please fill out required fields.

<https://www.mdcalc.com/calc/3939/ckd-epi-equations-glomerular-filtration-rate-gfr>



The good physician treats the disease; the great physician treats the patient who has the disease.
- William Osler

Review- Educational Objectives



Discuss criteria for the diagnosis and staging of Chronic Kidney Disease (CKD)

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Questions?

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