



Penn Medicine

What's the GFR!? Current Challenges in Cancer and Future Opportunities

OncoNephrology Symposium 2026

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17th September 2026

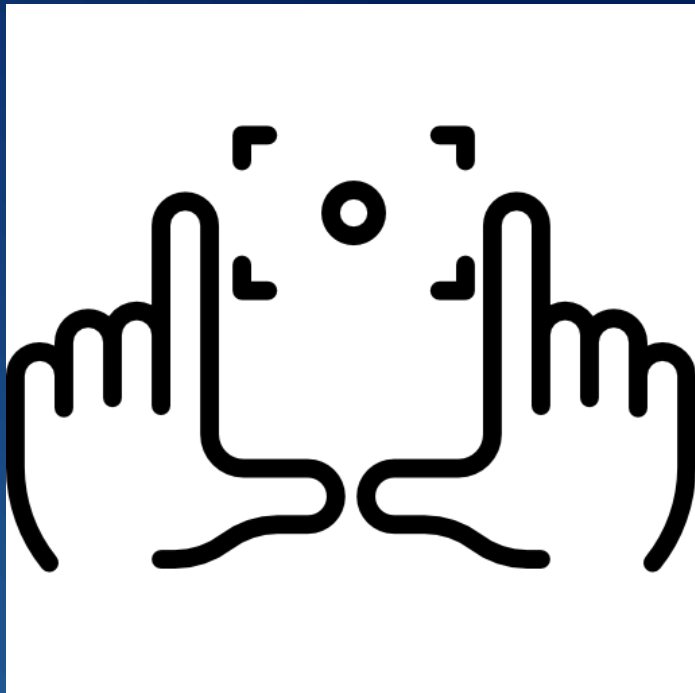
Disclosures

- None

Objectives

- Association of CKD and cancer
- Significance of GFR in cancer
- GFR assessment in cancer patients
- Society guidelines
- Impact of body composition on GFR assessment
- Future directions

CKD prevalence in cancer patients



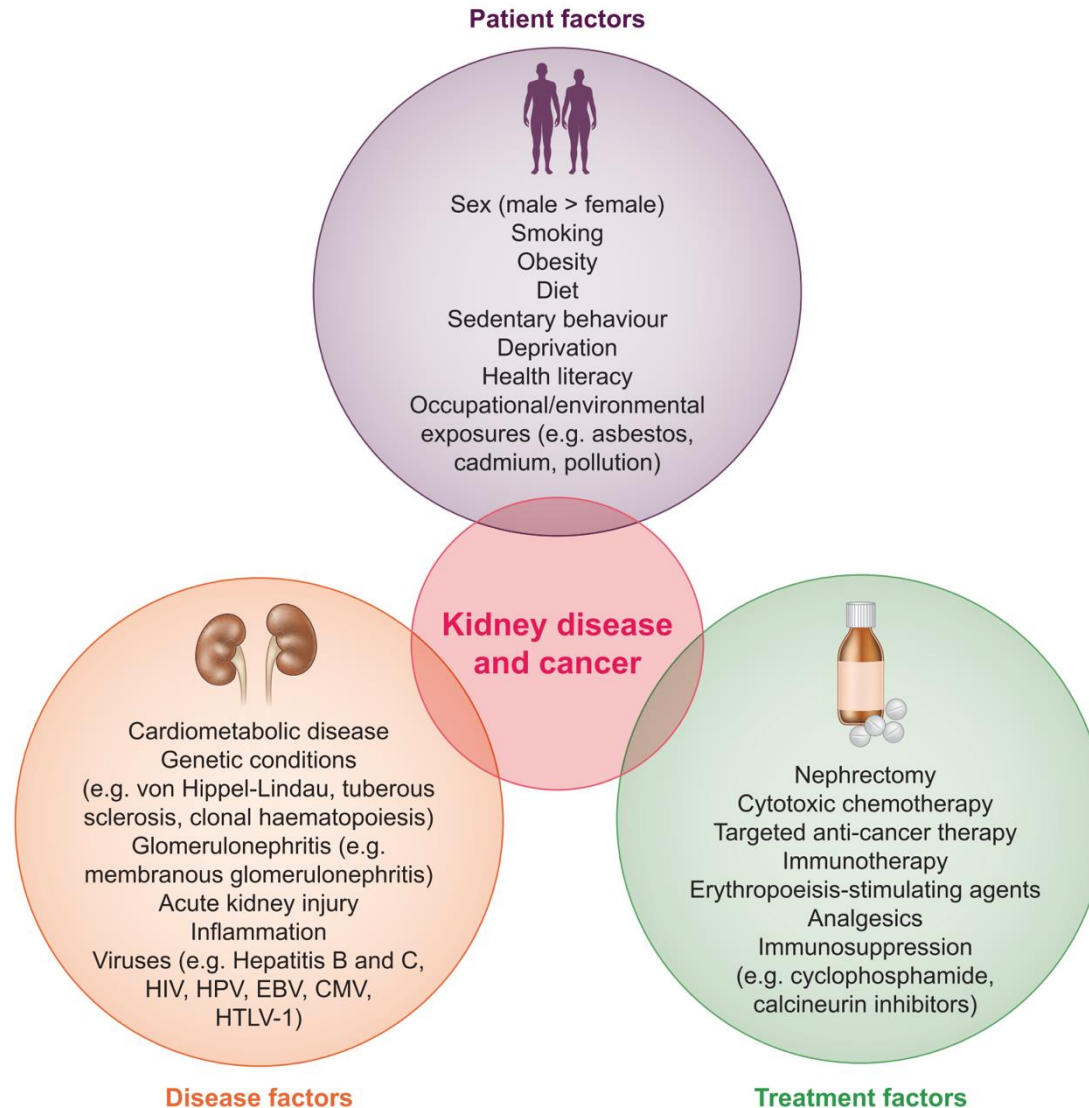
- CKD is common in cancer patients
- In the NHANES cohort, among 30,000 participants 32% patients with cancer had CKD and two thirds of this subgroup have eGFR between 30-60 ml/min per 1.73 m²
- In a French observational study of 4684 participants (IRMA), 12–20% had eGFR <60 mL/min/1.73 m²

Guo K et al., Association between chronic kidney disease and cancer including the mortality of cancer patients: national health and nutrition examination survey 1999-2014. Am J Transl Res. 2022

Launay-Vacher V et al., Renal Insufficiency and Cancer Medications (IRMA) Study Group. Prevalence of Renal Insufficiency in cancer patients and implications for anticancer drug management: the renal insufficiency and anticancer medications (IRMA) study. Cancer. 2007

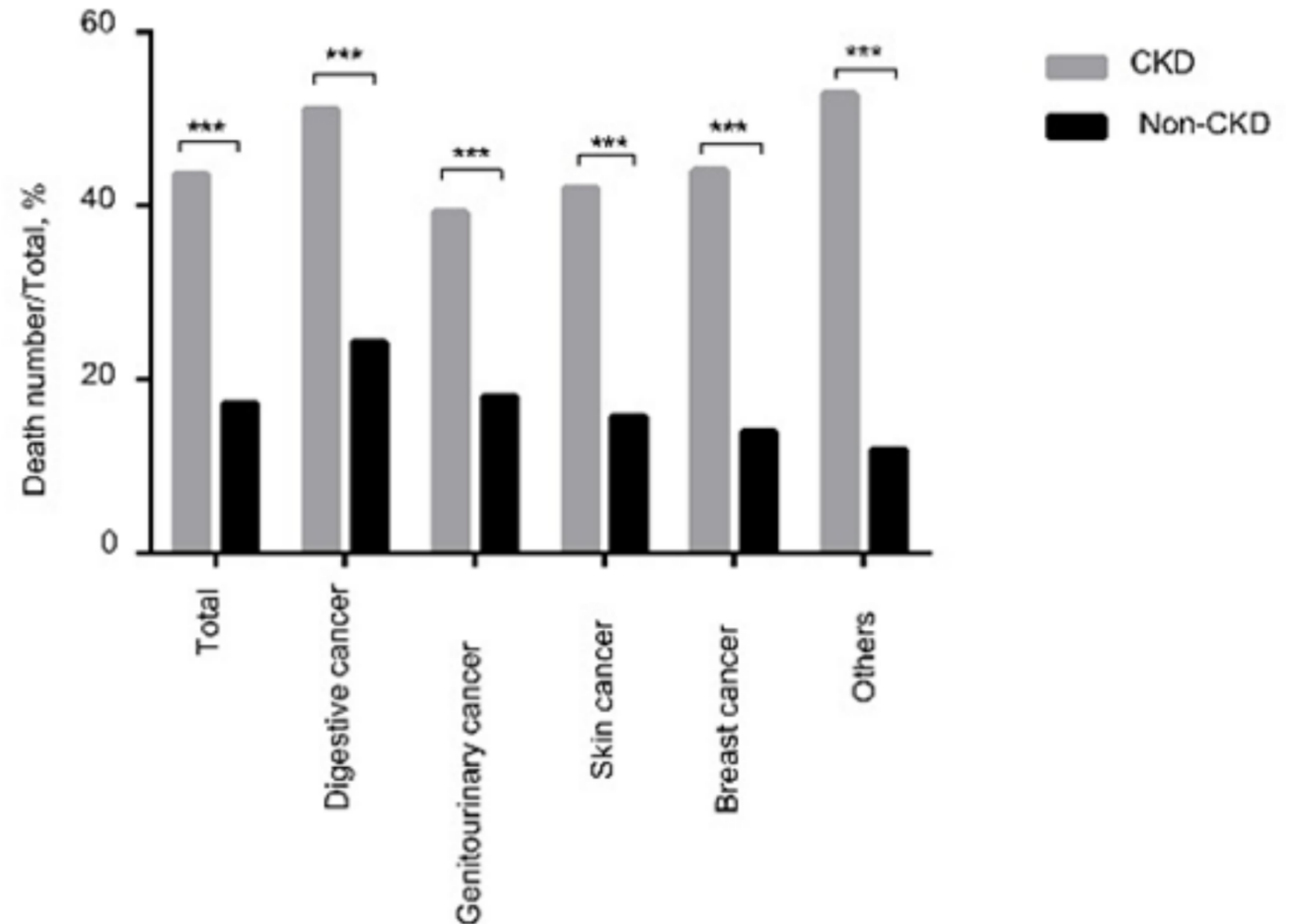
Lees JS et al., Kidney function and cancer risk: An analysis using creatinine and cystatin C in a cohort study. EClinicalMedicine. 2021

Patient, disease and treatment factors associated with kidney disease and cancer



Mortality in cancer patients with CKD

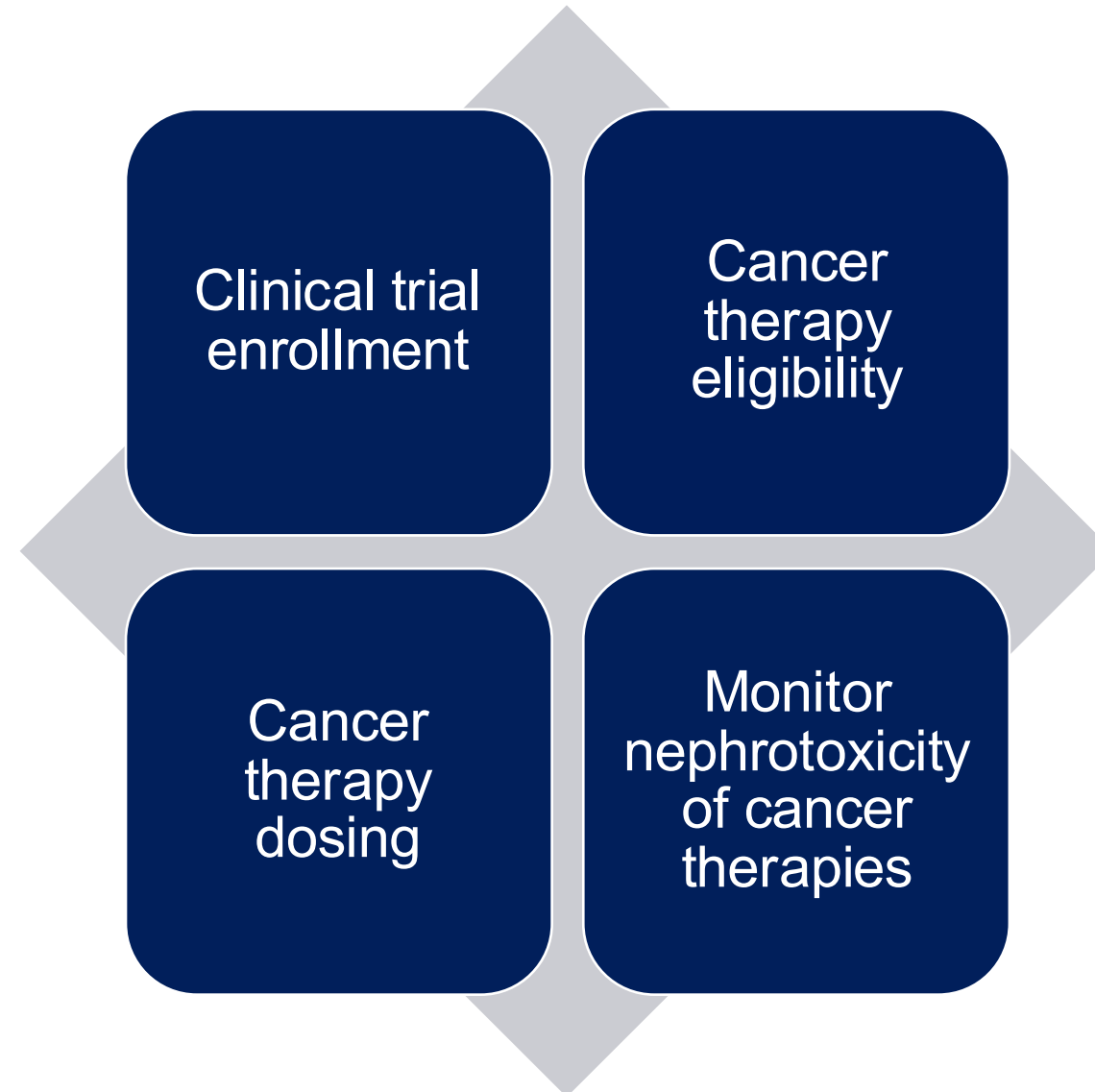
Mortality is higher in cancer patients with CKD compared to patients without CKD regardless of the type of cancer



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Significance of GFR in cancer patients



Are new cancer therapeutics being tested in patients with CKD?



Oncology drugs
approved 2015-2019



55 drugs



74 pivotal
trials

PIVOTAL TRIALS



kidney-related
eligibility criteria

95%

of trials



GFR-based
eligibility criteria

68%

of trials

creatinine
clearance

65%

GFR

8%

PHARMACOKINETIC ANALYSES

CKD
4 & 5

29%

of drugs

Dialysis



6%

of drugs

84%

creatinine
clearance

16%

GFR

NO KIDNEY DOSING INFORMATION



49%

of drugs

Conclusions: Patients with CKD are excluded from anticancer drug development. GFR estimation in pivotal trials and renal pharmacokinetic analyses remains imprecise and heterogeneous. Kidney-related safety and dosing information is scarcely and inconsistently presented.

Morgan A. Butrovich, Allison C. Reaves, Jamie Heyward, et al. *Inclusion of Participants with CKD and Other Kidney-Related Considerations during Clinical Drug Development*. CJASN doi: 10.2215/CJN.0000000000000105. Visual Abstract by Joel Topf, MD, FACP

Dosing of chemotherapeutic agents dependent on kidney function

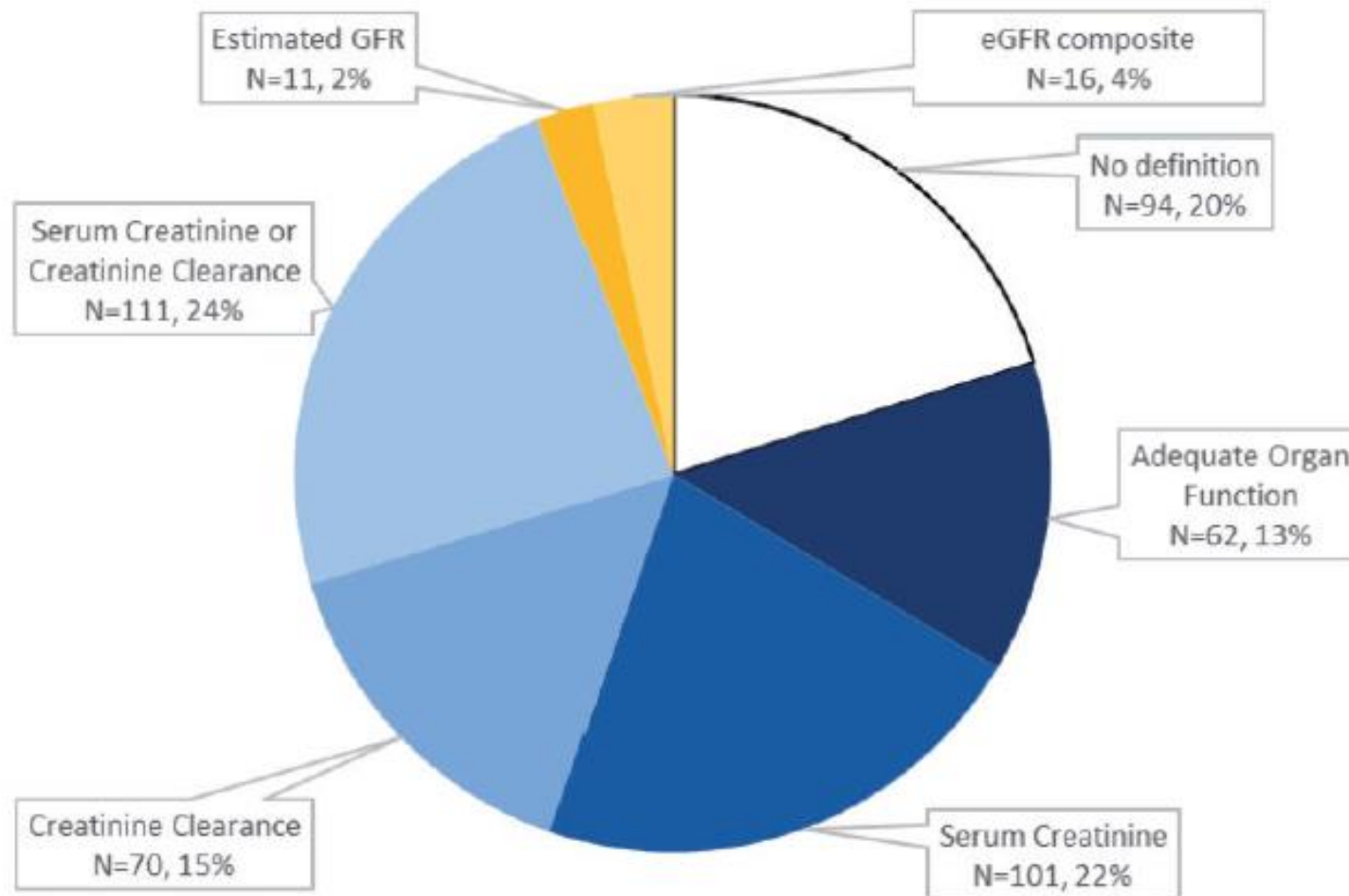
Table 2. Selected drugs with kidney function cutoffs for eligibility and dose modifications

Drug	Kidney Function Cutoff Below Which Not to Treat, ml/min	Kidney Function Ranges with Dose Modifications, ml/min	Reference
Bendamustine	30	—	42
Bleomycin	—	5%–10% to 40% 10%–20% to 45% 20%–30% to 55% 30%–40% to 60% 40%–50% to 70% 30%–50% to 75%	41
Capecitabine	30	—	43
Cisplatin	60	—	37
Etoposide	15	15%–50% to 75%	44
Fludarabine	30	30%–49% to 60% 50%–79% to 80%	45
Methotrexate	60	—	46
Mitomycin	30 ^a	—	47
Oxaliplatin	—	<30%–75%	48
Pemetrexed	45	—	49
Pentostatin	—	50%–60% to 50%	50
Topotecan	10	20%–39% to 50%	51

—, not applicable.

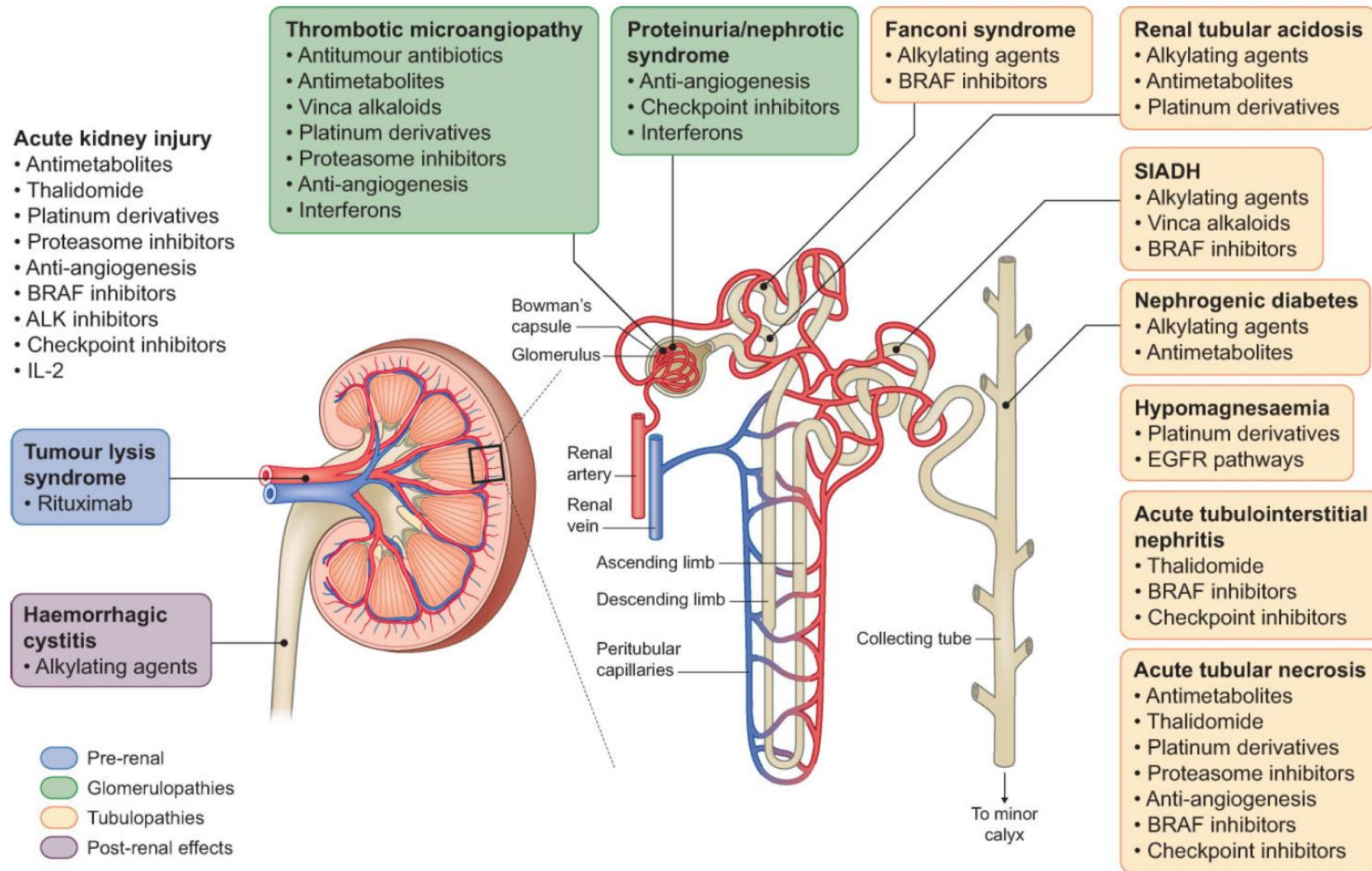
^aRelated to hydroxypropyl- β -cyclodextrin excipient.

Kidney function thresholds for cisplatin eligibility



In a random sample of clinical trials with cisplatin, serum creatinine and CrCl was used in 46% patients to assess kidney function for cisplatin eligibility and eGFR was used in only 2%

Nephrotoxicity of cancer therapies



Pseudo-AKI due to cancer therapies

Table 1. Targeted molecular anticancer agents, pseudo-AKI, and true kidney adverse effects^{6–10}

Target Receptor	Drug and Pseudo-AKI Incidence	Mechanism	Kidney AEs
ALK inhibitors	Alectinib (26%), brigatinib (2%), crizotinib (23%), ceritinib (33–58%), ensartinib (19%), entrectinib (13%–15%) lorlatinib (ND)	Inhibition of creatinine secretion <i>via</i> OCT-2, MATE-1, and MATE-2k	Pseudo-AKI, ATI, renal cyst formation (crizotinib), renal arteriolar vacuolization, crescentic GN and AIN (alectinib), proteinuria/podocytopathy (lorlatinib)
BCR-ABL	Imatinib (22%) (nilotinib and dasatinib not associated with pseudo-AKI)	Inhibition of creatinine secretion <i>via</i> OCT-2, OCT-3, MATE-1, and MATE-2k	Proteinuria, podocytopathy, FSGS-like changes (dasatinib)
BRAF inhibitors	Vemurafenib (97%)	Inhibition of creatinine secretion <i>via</i> OCT-2	Proteinuria, ATI, AIN
MET inhibitors	Capmatinib (24%), tepotinib (19%)	Inhibition of creatinine secretion <i>via</i> MATE-1 and MATE-2k	Pseudo-AKI
CDK 4/6 inhibitors	Palbociclib (13%), abemaciclib (11%–40%), ribociclib (22%–28%)	Inhibition of creatinine secretion <i>via</i> OCT-2, MATE-1, and MATE-2k	Pseudo-AKI, ATI
PARP inhibitors	Olaparib (22%), niraparib (23%), rucaparib (ND), and talazoparib (ND)	Inhibition of creatinine secretion <i>via</i> MATE-1 and MATE-2k, OCT-1 and OCT-2	Pseudo-AKI

AE, adverse effects; AIN, acute interstitial nephritis; ATI, acute tubular injury; ALK, anaplastic lymphoma kinase; BCR-ABL, breakpoint cluster region-abelson; BRAF, v-raf murine sarcoma viral oncogene homolog B1; CDK, cyclin-dependent kinase; MATE, multidrug and toxin extruder; MET, mesenchymal–epithelial transition; ND, not determined; OCT, organic cation transporter; PARP, poly(ADP-ribose) polymerase.

Important to diagnose pseudo-AKI to avoid unnecessary disruption or discontinuation of cancer-directed therapy

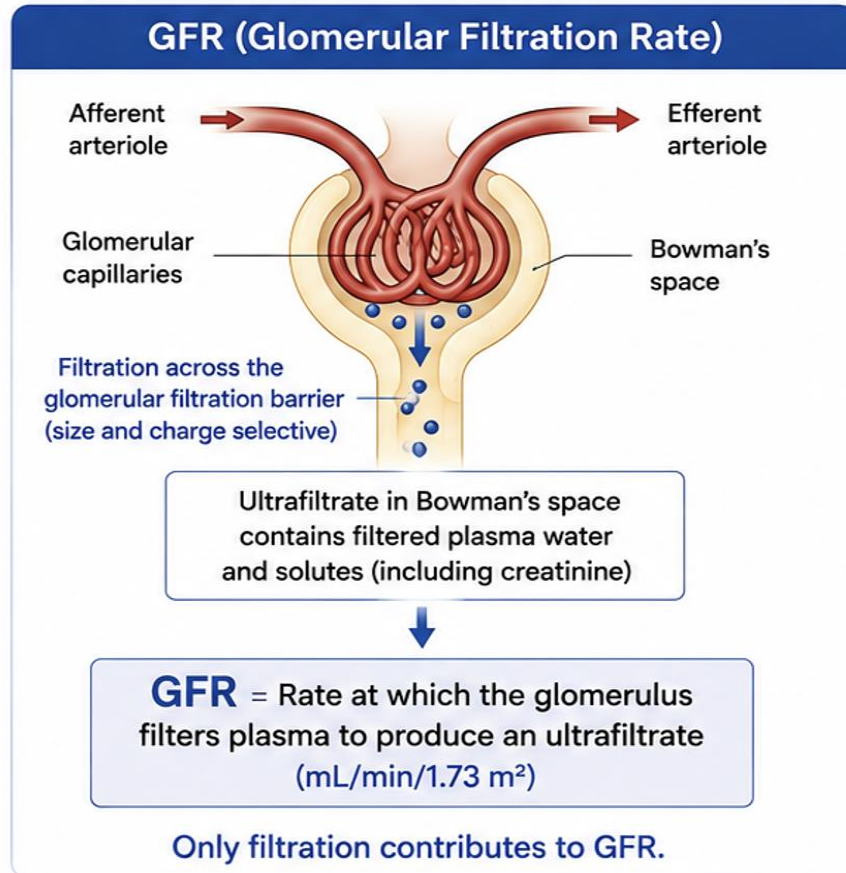
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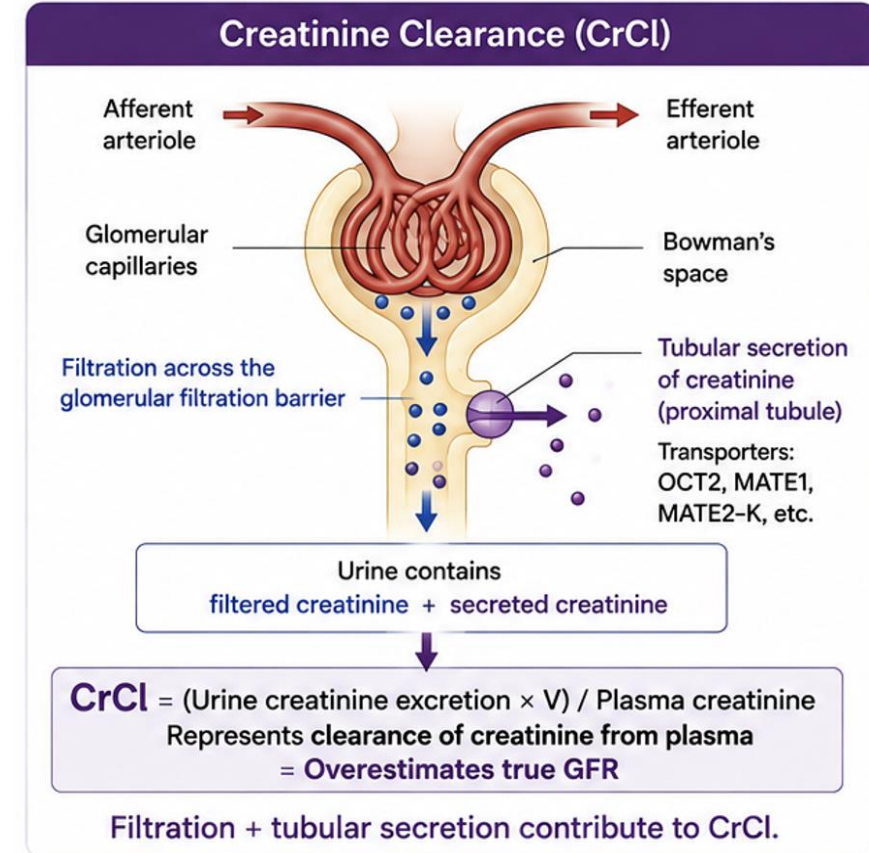
What's the GFR?

What is GFR?

What is GFR?



What is CrCl?



GFR ≠ CrCl

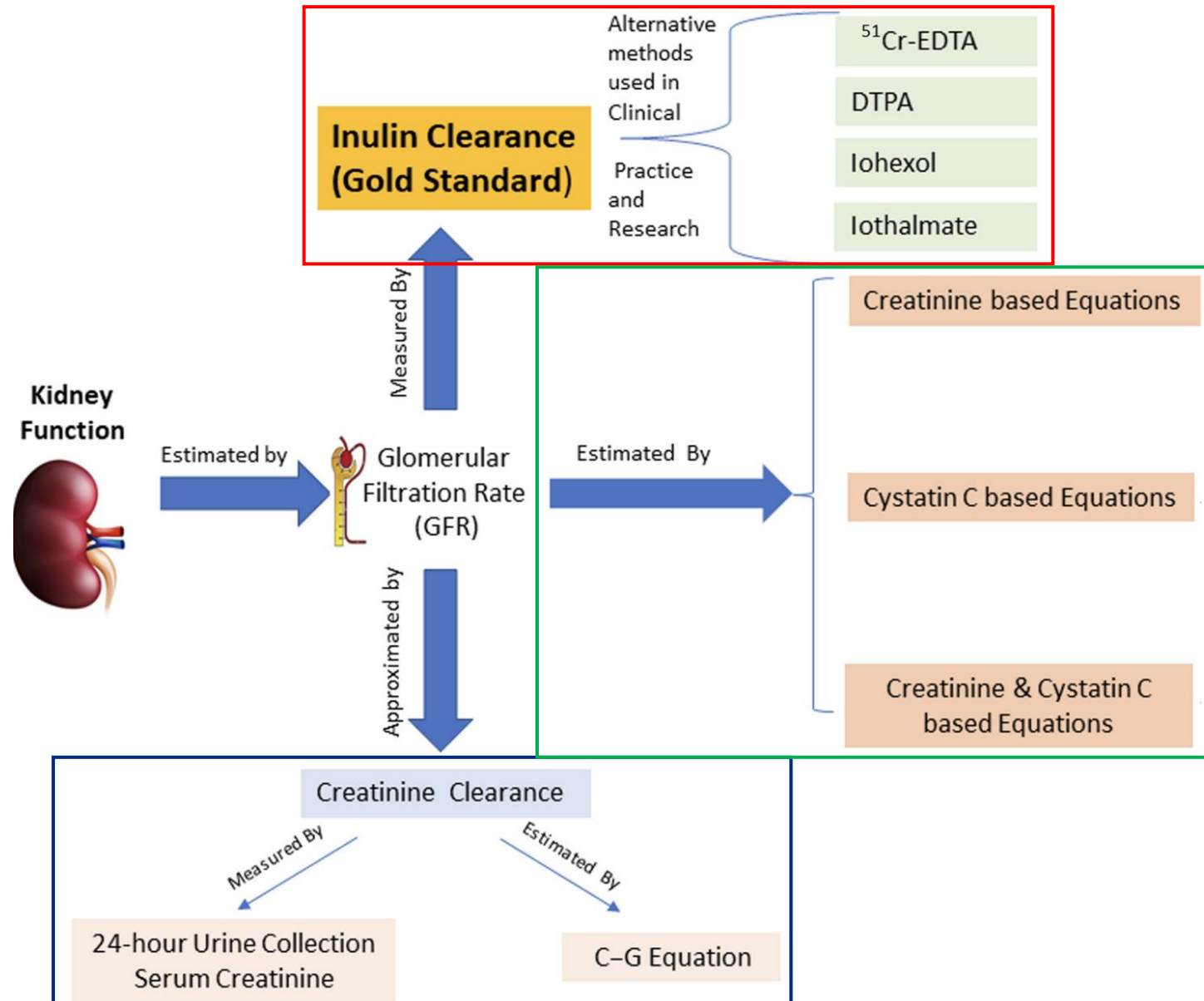
CrCl overestimates GFR by 10-40% due to tubular secretion of creatinine
CrCl can be estimated (CG CrCl equation) or measured (24 hr-urine CrCl)

Cockcroft–Gault (CG) creatinine clearance equation

$$\text{CrCl} = \frac{(140 - \text{age}) \times \text{weight (kg)}}{72 \times \text{SCr (mg/dL)}} \times (0.85 \text{ if female})$$

- **249 white males**
- Multiplied by **0.85 for 15% adjustment for female sex** was estimated based on **expert opinion**
- Reference method was **not measured GFR** but 24-hour urine CrCl
- Developed in **1976** when serum creatinine assays were not standardized
- In **2011**, serum creatinine assay methods were standardized to an isotope dilution mass spectrometry (IDMS) reference measurement procedure so average serum creatinine value decreased by **12%**

Methods used to assess kidney function



GFR assessment

- Estimate GFR using endogenous markers and equations
- Measure GFR using exogenous markers

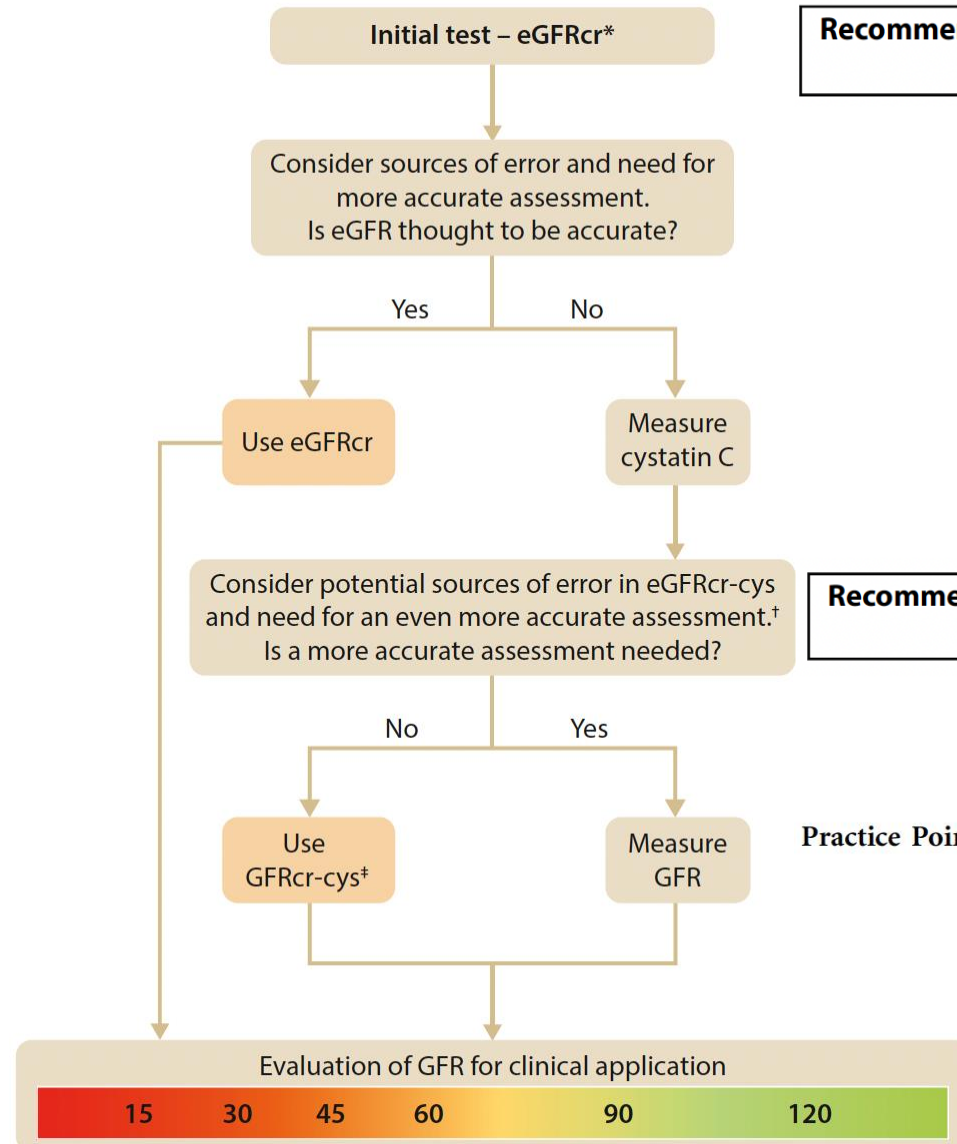
Table 1-1. Endogenous Markers and Equations Used to Estimate GFR (eGFR)

Method / Equation	Biomarker(s)	Brief Description	Key Strengths	Key Limitations	Current Role
 Serum Creatinine (alone)	Creatinine	Single serum measurement used as surrogate of filtration	✓ Widely available; inexpensive; standardized assays	⚠ Influenced by muscle mass, diet, medications; delayed rise in AKI; tubular secretion	 Routine screening and longitudinal monitoring
 Creatinine-based eGFR (CKD-EPI, race-free)	Creatinine	Population-derived equation estimating GFR	✓ Improved accuracy across CKD stages and races; broadly implemented	⚠ Inaccurate in non-steady state; biased at extremes of body composition	 First-line eGFR in most clinical settings
 Cystatin C-based eGFR	Cystatin C	Muscle-independent endogenous filtration marker	✓ Better performance when creatinine unreliable; earlier AKI detection	⚠ Affected by inflammation, steroids, thyroid disease; higher cost	 Confirmatory testing; inpatient and high-risk patients
 Combined Creatinine-Cystatin C eGFR	Creatinine + Cystatin C	Race-free combined equation	✓ Highest accuracy and precision across all CKD stages and patient populations	⚠ Limited availability of cystatin C; still population-based	 Preferred eGFR when available (NKF/ASN)
 Cockcroft-Gault (C-G)	Creatinine	Estimates creatinine clearance using age, sex, weight	✓ Historically used for drug dosing	⚠ Non-IDMS standardized; poor accuracy; biased derivation	 Legacy use; Pharmaceutical considerations
 MDRD	Creatinine	1st eGFR equation to predict mGFR, derived from CKD population	✓ Improved over C-G in CKD	⚠ Underestimates GFR at higher function	 Largely obsolete
 EKFC-FAS	Creatinine ± Cystatin C	Full age spectrum equation normalized to age-specific creatinine benchmarks	✓ Application across lifespans	⚠ Dependent on population reference values; limited use in U.S.	 Research and select clinical settings; increasing use in Europe
 CKiD-U25	Creatinine ± Cystatin C	Pediatric and young adult equation derived from the CKiD cohort.	✓ Better pediatric accuracy	⚠ Population-specific limitations	 Pediatric nephrology practice

Abbreviations: AKI, acute kidney injury; CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; IDMS, isotope dilution mass spectrometry; NKF, National Kidney Foundation; ASN, American Society of Nephrology.

Adapted from Brady et al. Kidney360 2026

KDIGO 2024: Approach to GFR evaluation using initial and supportive tests



Recommendation 1.2.4.1: We recommend using a validated GFR estimating equation to derive GFR from serum filtration markers (eGFR) rather than relying on the serum filtration markers alone (1D).

Recommendation 1.2.2.1: We recommend using eGFRcr-cys in clinical situations when eGFRcr is less accurate and GFR affects clinical decision-making (Table 8¹²⁷⁻¹⁴²) (1C).

Practice Point 1.2.2.2: Where more accurate ascertainment of GFR will impact treatment decisions, measure GFR using plasma or urinary clearance of an exogenous filtration marker (Table 9).

Non-GFR determinants of Creatinine and Cystatin-C

Creatinine	
Falsely high	• Cancer therapies cause pseudo-AKI • High protein diet • Supplements: creatine
Falsely low	• Sarcopenia • Low muscle mass • Low protein diet

Cystatin-C	
Falsely high	• Obesity • Smoking • Pro-inflammatory states • Steroids • Thyroid disorders • ?Certain cancers • ?Cancer therapies
Falsely low	• Thyroid disorders

KDIGO 2024: Utilization of Measured GFR

Table 7 | Description of initial and supportive tests for the evaluation of GFR

GFR assessment method	Specific tests	Guidance for use and implementation
Estimated GFR	Creatinine (eGFR _{cr})	Most used method to assess GFR. In most cases, initial test for the evaluation of GFR. Standardized assay required to decrease between-center analytical variation
	Cystatin C (eGFR _{cr-cys} , eGFR _{cys})	Used in selected circumstances as listed in Table 8 . Standardized assay required to decrease between-center analytical variation
mGFR	Gold standard. Urinary or plasma clearance of exogenous markers (e.g., iohexol, iothalamate, ⁵¹ Cr-EDTA, and ^{99m} Tc-DTPA)	Used in selected circumstances as listed in Table 8 . Standard protocols for clearance methods and for the standardized assay
Timed urine clearance	Creatinine	Highly prone to errors and recommended only when no other options for supportive tests for GFR evaluation; performance under supervised conditions may decrease error
Nuclear medicine imaging	Imaging of the kidneys after injection of tracer cleared by the kidneys (e.g., ^{99m} Tc-DTPA scintigraphy)	Highly prone to errors; not recommended

⁵¹Cr-EDTA, chromium 51-labeled ethylenediaminetetraacetic acid; ^{99m}Tc-DTPA, technetium 99m-labeled diethylenetriamine pentaacetate; eGFR_{cr}, creatinine-based estimated GFR; eGFR_{cr-cys}, creatinine and cystatin C–based estimated GFR; eGFR_{cys}, cystatin C–estimated GFR; GFR, glomerular filtration rate; mGFR, measured glomerular filtration rate.

Cancer ^{a,132-137}	Chronic illness, presumed impact on non-GFR determinants of SCr and SCys	eGFR _{cr-cys} demonstrated to be most accurate in populations studied but likelihood of lesser accuracy in more frail people or in cancers with high cell turnover. Suggest using mGFR for treatment decisions based on the level of GFR.
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ACCURATE ASSESSMENT OF
KIDNEY FUNCTION IS
IMPORTANT IN PATIENTS
WITH CANCER



**How do eGFR equations perform
in patients with cancer?**



Performance metrics for GFR estimating equations

Commonly used performance metrics for GFR estimating equations

- Accuracy: defined as the percentage of estimates that differed by more than 30% from the measured GFR ($mGFR$; $1 - P_{30}$) and represents the percentage of large errors, which can be clinically significant. A $1 - P_{30}$ of 10%–20% is generally considered adequate for many clinical decisions.
- Bias: defined as the median of the differences between $mGFR$ and $eGFR$ and provides insight into non-GFR determinants of the filtration markers. Positive and negative values represent and underestimate and overestimate of $mGFR$, respectively.
- Precision: is expressed as the interquartile range of the differences between $mGFR$ and $eGFR$.
- P_{30} is the proportion of $eGFR$ value within 30% of measured GFR
- These thresholds (10%, 20%, 30%) are suitable when comparing different equations to each other but variation of up to 30% may have clinical implications at an individual patient level

A Prospective cross-sectional study estimated glomerular filtration rate from creatinine and cystatin C in adults with solid tumors

Methods

1,200 prospectively recruited adult patients with solid tumors



COMPARISON

mGFR

Measured GFR
Plasma clearance of
⁵¹Cr-EDTA

vs

eGFR

Estimated GFR
Creatinine, Cystatin C

Costa e Silva, VT 2021

Results

Performance of GFR estimating equations

Filtration marker	Equation	Bias (median) (ml/min/1.73 m ²)	Accuracy (1-P30) (%)
 Age: 58.8 (13.2) y mGFR 78.4 (21.7) ml/min/1.73 m ²	CG	-8.1 (-9.4 to -6.7)	24.9 (22.4 – 27.3)
	MDRD	-4.8 (-6.0 to -3.6)	18.2 (16.0 – 20.3)
	CKD-EPI 2009	-8.1 (-8.9 to -7.1)	19.1 (16.8 – 21.2)
Creatinine	CamGFRv2	6.1 (5.3 – 6.9)	7.2 (5.7 – 8.7)
	CKD-EPI 2012	4.6 (3.7 to 5.5)	12.3 (10.3 – 14.3)
	Both	-2.0 (-2.6 to -1.1)	7.8 (6.3 – 9.4)
Cystatin C	CKD-EPI 2012	4.6 (3.7 to 5.5)	12.3 (10.3 – 14.3)
	Both	-2.0 (-2.6 to -1.1)	7.8 (6.3 – 9.4)

**Cockcroft-Gault (CG) was the most biased and the least accurate.
CKD-EPI creatinine-cystatin C was the least biased and the most accurate.**

CONCLUSION *The CG equation should not be preferred over the 2009 CKD-EPI creatinine equation, and the 2012 CKD-EPI creatinine-cystatin C equation can be used as a confirmatory test in adults with solid tumors.*

Prospective Cross-Sectional Study on the Performance of the 2021 CKD-EPI Equations Without Race in a Multiracial Population of Adults With Solid Tumors in Brazil

Table 1. Performance of Glomerular Filtration Rate Estimating Equations

Filtration Marker (eGFR)	Equation	Use of Race	Bias (Median) (mL/min/1.73 m ²)	Precision (IQR) (mL/min/1.73 m ²)	Accuracy (1-P ₃₀) (%)	Accuracy (RMSE)
Creatinine (eGFRcr)	CG 1976	No	-8.1 (-9.4 to -6.7)	24.2 (22.4-25.8)	24.9 (22.4-27.3)	0.239 (0.229-0.249)
Creatinine (eGFRcr)	CKD-EPI 2009	Yes	-8.1 (-8.9 to -7.1)	18.4 (17.1-19.6)	19.1 (16.8-21.2)	0.206 (0.197-0.215)
Creatinine (eGFRcr)	CKD-EPI 2021	No	-10.0 (-10.7 to -8.8)	18.2 (17.0-19.6)	22.3 (19.8-24.4) ^a	0.220 (0.211-0.230)
Cystatin C (eGFRcys)	CKD-EPI 2012	No	4.6 (3.7-5.5)	17.5 (16.3-19.2)	12.3 (10.3-14.3)	0.215 (0.204-0.225)
Creatinine-cystatin C (eGFRcr-cys)	CKD-EPI 2012	Yes	-2.0 (-2.6 to -1.1)	15.9 (14.7-16.8)	7.8 (6.3-9.4)	0.165 (0.157-0.172)
Creatinine-cystatin C (eGFRcr-cys)	CKD-EPI 2021	No	-4.1 (-4.8 to -3.3)	15.7 (14.6-17.1)	9.8 (8.0-11.4) ^b	0.171 (0.163-0.179)

- CKD-EPIcr 2021 equation was more accurate than the CG equation
- eGF- EPIcr-cys 2021 combines equation was more accurate than the 2021 eGFRcr only equation and the 2012 eGFRcys only equation

Performance of creatinine and cystatin-based equations on estimating measured GFR in people with hematological and solid cancers



All patients with cancer and who had mGFR by urinary iothalamate clearance (2011 – 2023)



Use of an electronic health record diagnosis code for cancer within 2 years prior to mGFR



CKDEPI, EKFC, and CG equations

CKDEPI: Chronic Kidney Disease Epidemiology Collaboration;
EKFC: European Kidney Function Consortium ; CG: Cockcroft-Gault

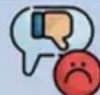
1145 patients with creatinine and cystatin C available within 7 days of mGFR



CKDEPI_{crcys} provided the best performance with small bias (median 3.0, 95% CI 2.3-3.8) and higher precision (RMSE 14.5) compared to creatinine-only or cystatin-only equation (RMSE varying from 16.6 to 20)



EKFC_{crcys} had similar performance to CKDEPI_{crcys} (RMSE 14.9)



CG showed worst precision (30% of people with errors above 30%)



CKDEPI_{cys} was the most biased (underestimation of mGFR)

Conclusions: In patients with cancer, CKDEPI_{crcys} performed best for GFR assessment, and this was true for both solid and hematological cancers. Our findings give support for the preferential use of creatinine and cystatin C-based equations instead of creatinine-only or cystatin C-only equations in this population.

Silvia M Titan, John C Lieske, Jeffrey W Meeusen, et al. *Performance of creatinine and cystatin-based equations on estimating measured GFR in people with hematological and solid cancers*. CJASN DOI: 10.2215/CJN.0000000616
Visual Abstract by José A. Moura-Neto, MD, FASN, FRCP, FACP

eGFR Discordance and its Association with Outcomes following Allogeneic Hematopoietic Stem Cell Transplantation and Adoptive T-Cell Therapies

Cohort

Multicenter cohort study



Adults receiving allogeneic HSCT and adoptive T-cell therapies who had paired serum creatinine and cystatin C values obtained in the 30 days preceding conditioning or lymphodepleting chemotherapy

HSCT- hematopoietic stem cell transplant
AKI- acute kidney injury

Primary exposure



eGFR discordance
($\text{eGFR}_{\text{cys}} \geq 30\%$ lower than eGFR_{cr})

Primary outcome



Composite outcome of AKI
($\geq 50\%$ increase in serum creatinine/ kidney replacement therapy) or **death within 90 days** following HSCT or adoptive T-cell infusion

Outcomes

Parameters	Patient receiving HSCT (n=274)	Patient receiving adoptive T-cell therapies (n=236)
Median age (years)	65	67
Females (%)	43	59
eGFR discordance	86 (31%)	78 (33%)
Higher odds of AKI or death	OR 1.75 95% CI, 1.03 to 3.02	OR 2.37 95% CI, 1.12 to 4.94
eGFR discordance associated with	slower time-to-platelet engraftment	prolonged cytopenia



Adjustment for $\text{eGFR}_{\text{cr-cys}}$ attenuated the association of AKI/death in both cohorts

Conclusions: A pre-treatment eGFR discordance was associated with AKI or death in HSCT and adoptive T-cell recipients; however, this association was attenuated after adjusting for $\text{eGFR}_{\text{cr-cys}}$

Api Chewcharat, Rajesh Anumolu, Aditya Suresh, et al. **eGFR Discordance and its Association with Outcomes following Allogeneic Hematopoietic Stem Cell Transplantation and Adoptive T-Cell Therapies.** JASN DOI: 10.1681/ASN.0000001119. Visual Abstract by Kajaree Giri MD, DM

ASON Position Statement Committee

Systematic literature review of the accuracy of equations to estimate GFR in adult patients with cancer

- 39 studies that assessed the accuracy of eGFR equations using serum creatinine and/or cystatin C versus an exogenous filtration marker
- Total number of patients was 21,949
 - 19,025 with solid cancers, 1146 with hematologic cancers and 1778 unspecified malignancies

Summary of GFR estimating equations assessed in studies identified by systematic literature review

First Author	Cancer Type(s) & Number of patients (N)	Cr Assay Std.	mGFR method	eGFR Equation(s) Assessed ^{a,b}								Overall Study Quality	Most Accurate eGFR Equation(s) as Reported by Study	P30 or Other Performance Metrics (for most accurate eGFR equation vs mGFR)
				CG	Jelliffe	Wright	MDRD	CKD-EPI-Cr	CKD-EPI-Cys	CKD-EPI-Cr+Cys	Janowitz (CamGFR v1)	CamGFR v2		
Barracough, LH ⁵⁰	Multiple sites ^c (367)	Yes	^{99m} Tc-DTPA (P)										Wright	MPE: 2 MAPE: 19
Chancharoenthana, W ³³	Multiple sites ^d (320)	Yes	^{99m} Tc-DTPA (P)										CKD-EPICr	P30: 96
Chew-Harris, JS ²⁰	Multiple sites (80)	Yes	^{99m} Tc-DTPA (P)										CKD-EPICr	P30: 76
Chew-Harris, JS ³²	Multiple sites (80)	Yes	^{99m} Tc-DTPA (P)										CKD-EPI Cr-Cys	P30: 82
Costa E Silva, VT ¹⁸	Multiple sites (1200) ^c	Yes	⁵¹ Cr-EDTA (P)										CKD-EPI Cr-Cys	P30: 92 (91, 94)
Costa E Silva, VT ⁴⁸	Multiple sites (1200) ^c	Yes	⁵¹ Cr-EDTA (P)										CKD-EPI Cr-Cys 2021 (race free model)	P30: 90.2 (88.6, 92)
Craig, AJ ⁵¹	Multiple sites (288) ^d	Yes	⁵¹ Cr-EDTA (P)										CG	P30: 75
Gamer, AE ⁵²	Multiple sites ^c (120)	Yes	^{99m} Tc-DTPA (P)										CamGFRv1 MDRD	P30 shown graphically for both equations
Hingorani, S ⁵³	HSCT (50)	Yes	Iohexol (P)										CKD-EPI-Cys	P30: 76
Lauritsen, J ⁵⁴	Germ Cell (94)	Partial	⁵¹ Cr-EDTA (P)										CG Wright	P30: 93 (CG) 92 (Wright)
Lindberg, L ⁵⁵	Head and Neck (94)	Partial	⁵¹ Cr-EDTA (P)										CG	Bland-Altman graph
McLean, L ⁵⁶	Multiple sites (470) ^d	Yes	⁵¹ Cr-EDTA (P)										MDRD	MPE (carboplatin dose for an AUC of 6): 8.3 (6.2, 10.4)
Rouanne, M ⁵⁷	Bladder (36)	Yes	⁵¹ Cr-EDTA (U)										CamGFRv1	MdnAD: -5.1 Pre-surgery
Samani, A ³⁷	Gynecologic (486)	Yes	⁵¹ Cr-EDTA (P)										CamGFRv2	P30: 86 (Imperial cohort) 95 (Guy's cohort)
Shepherd, ST ²⁹	Seminoma (115)	Yes	⁵¹ Cr-EDTA (P)										CKD-EPICr	P30: 90
Tong Y ¹⁹	Multiple sites ^d (545)	Yes	^{99m} Tc-DTPA (P)										CKD-EPI Cr-Cys	P30: 99
Williams EH ³⁶	Multiple sites ^d (6978)	Partial	⁵¹ Cr-EDTA/Iohexol (P)										CamGFRv2	MdnAD: shown graphically Proportion with percentage error in carboplatin dose >20%: 0.16 (0.13, 0.18)

After excluding low-quality studies, the **CKD-EPI creatinine–cystatin C** equation was most frequently reported as the most accurate

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Key messages for the assessment of GFR in patients with cancer

AMERICAN SOCIETY OF ONCO-NEPHROLOGY

1.1: All patients initiating anticancer treatment should undergo baseline estimation of GFR before the start of therapy

1.2: A contemporary, validated estimating equation using serum filtration markers(s) should be used when assessing GFR in patients with cancer

1.3: Clinicians should be aware of shortcomings of creatinine-based equations, and if possible, use validated GFR estimating equations incorporating serum creatinine and serum cystatin C (i.e., eGFR_{Cr-Cys}) for decision making related to anticancer therapy eligibility and dose-adjustment

1.4: Clinicians should avoid use of non-validated equations (e.g., the CG formula) for decision making related to anticancer therapy eligibility and dose-adjustment

1.5: Consider obtaining a mGFR via an exogenous filtration marker in patients with cancer for whom eGFR results in borderline eligibility for specific therapies or clinical trial inclusion

Non-GFR determinants of Creatinine and Cystatin-C

Creatinine	
Falsely high	• Cancer therapies cause pseudo-AKI • High protein diet • Supplements: creatine
Falsely low	• Sarcopenia • Low muscle mass • Low protein diet

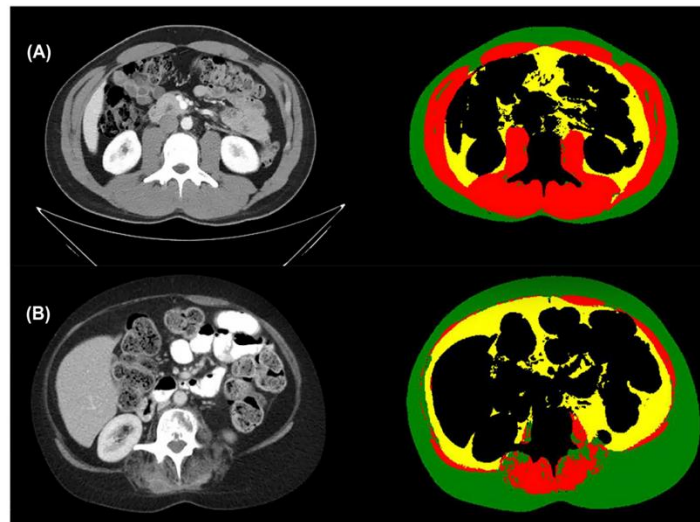
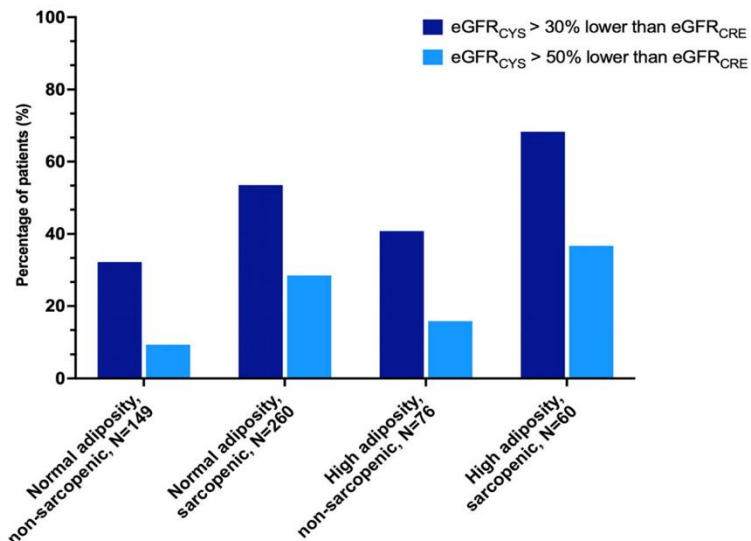
Cystatin-C	
Falsely high	• Obesity • Smoking • Pro-inflammatory states • Steroids • Thyroid disorders • ?Certain cancers • ?Cancer therapies
Falsely low	• Thyroid disorders

Objectives

- Association of CKD and cancer
- Significance of GFR in cancer
- GFR assessment in cancer patients
- Society guidelines
- **Impact of body composition on GFR assessment**
- Future directions

Discordance between eGFR_{Cr} and eGFR_{Cys} patients with cancer due to sarcopenia and adiposity

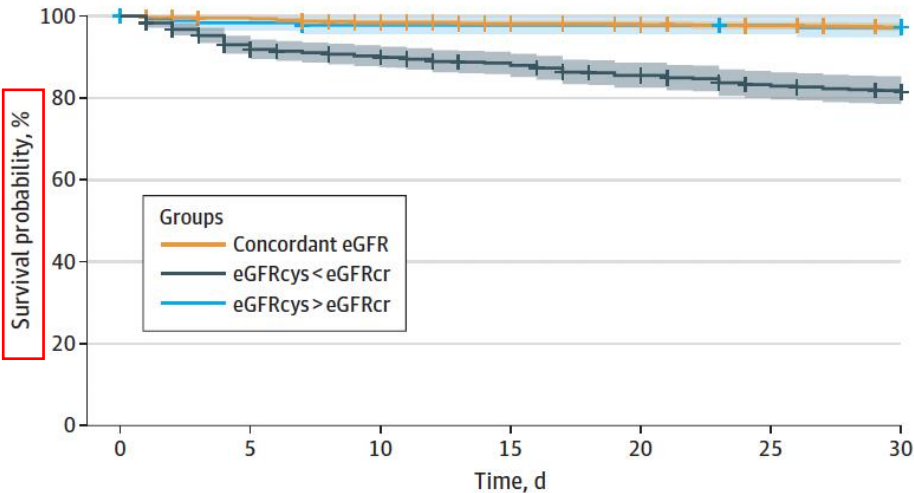
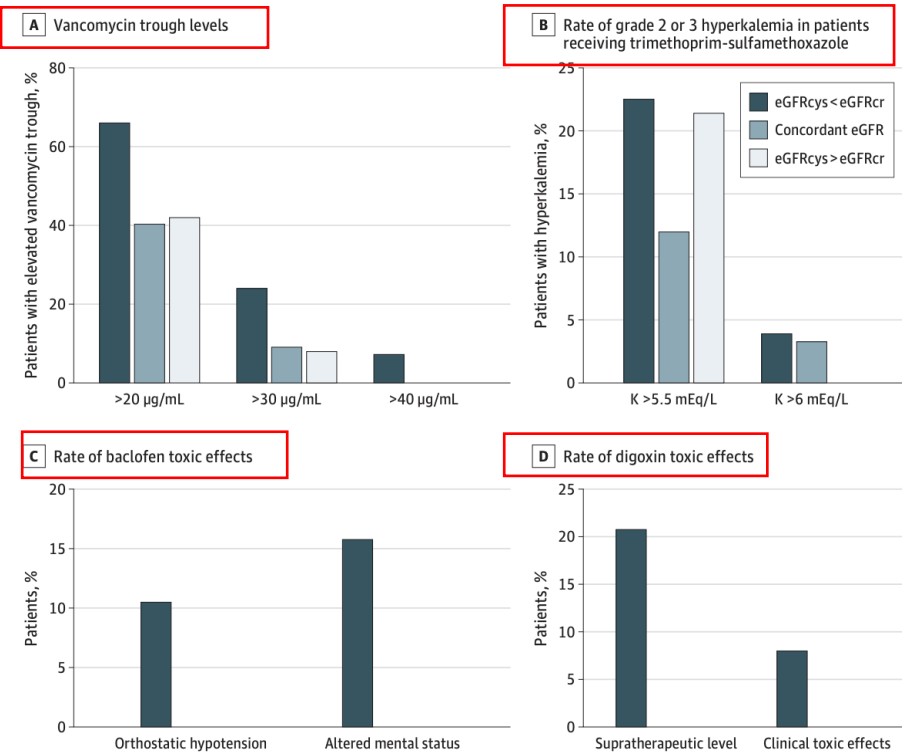
545 adult cancer patients with abdominal CT performed within 90 days of simultaneous eGFR_{Cr} and eGFR_{Cys} measurements



- CT sarcopenia: 59%
- High adiposity: 25%
- High adiposity + sarcopenia: 44%
- Both sarcopenia and adiposity were independently associated with large eGFR discordance (OR ~2.0)

Discordance in eGFRcys and eGFRcr and medication-related adverse events in patients with cancer

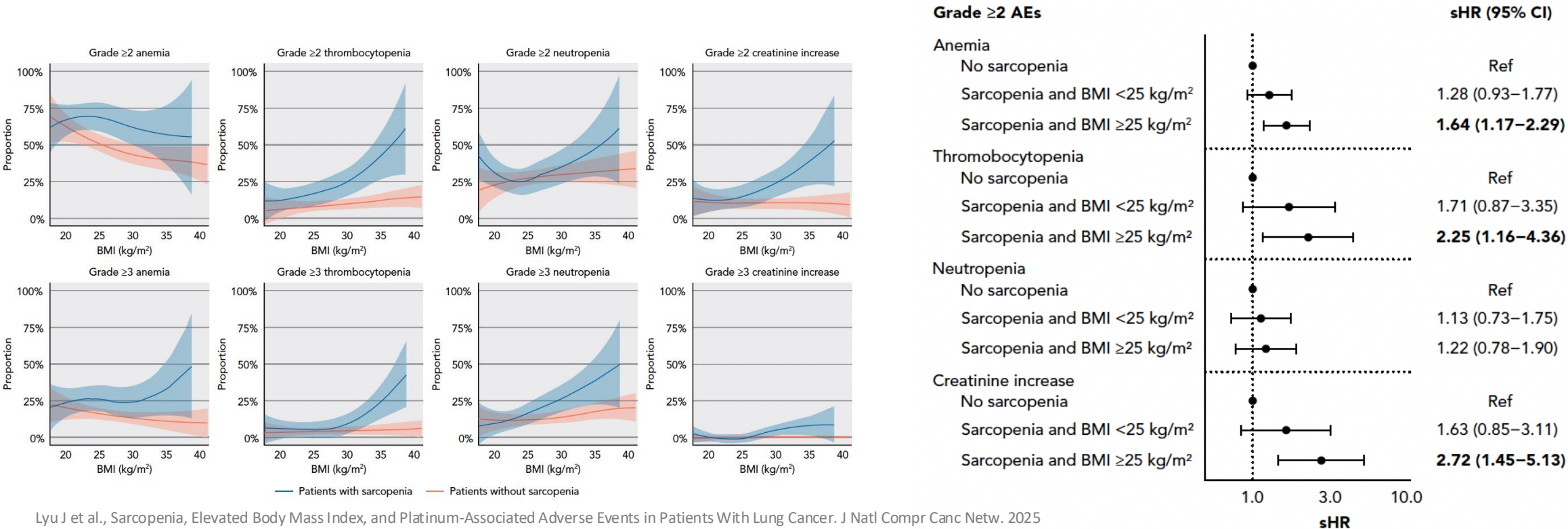
- 1869 patients with simultaneous eGFRcys and eGFRcr measurement
- 29% had discordant eGFR: eGFRcys >30% lower than eGFRcr
- Supratherapeutic drug levels and medication-related adverse events are more common in patients with discordant eGFR



No. at risk							
Concordant eGFR	1131	1063	1047	1034	1029	1021	1014
eGFRcys < eGFRcr	543	484	465	444	424	407	397
eGFRcys > eGFRcr	195	176	174	174	174	173	172

Sarcopenia, elevated BMI, and platinum-associated adverse events in lung cancer

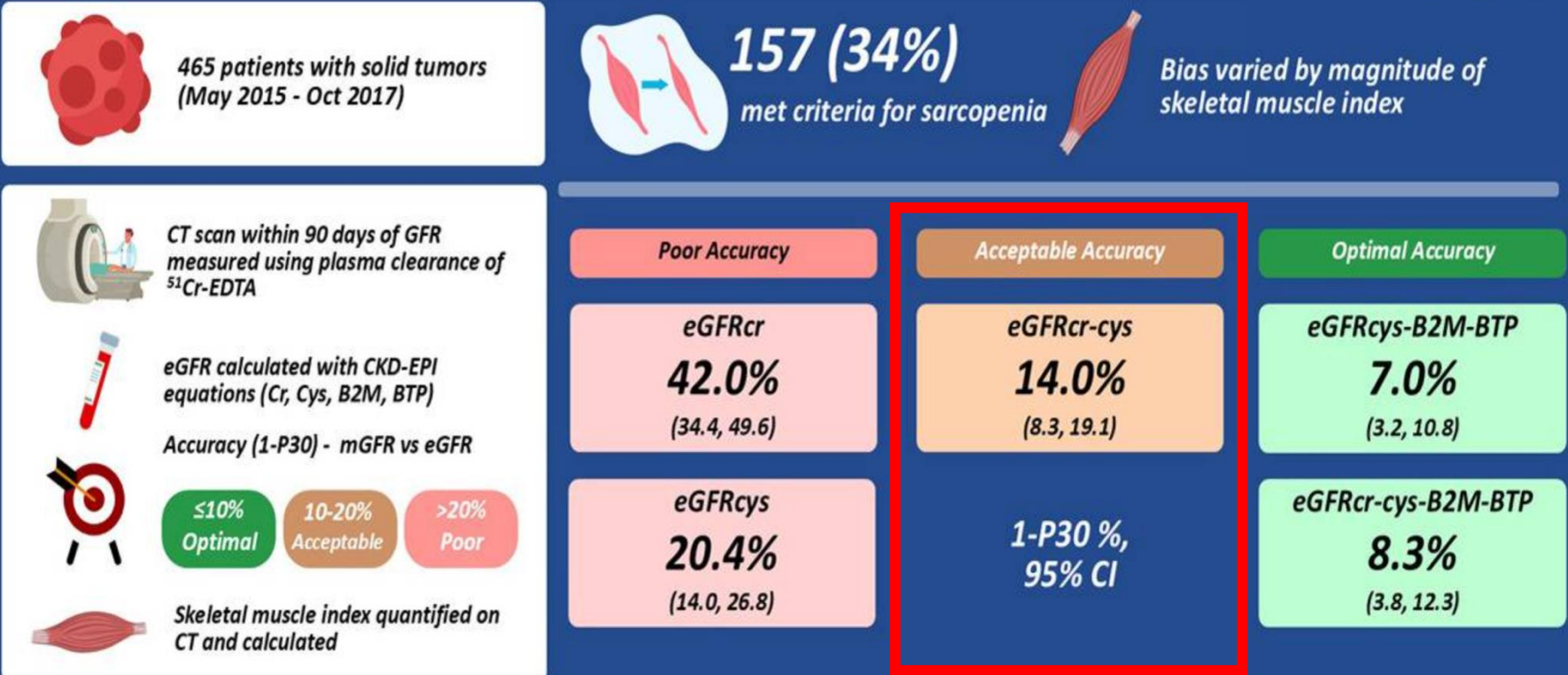
- 604 patients
- Sarcopenia and high BMI (>25 kg/m²) increased risk of anemia, thrombocytopenia and AKI
- CG-CrCL based carboplatin dosing that exceeded CKD-EPI–based dosing by ≥25 mg was associated with a higher risk of grade ≥2 adverse events



Impact of CT-derived Body Composition Analysis on the Performance of GFR Estimating Equations in Patients with Cancer

CJASN

Clinical Journal of the American Society of Nephrology
Clinical Research



Cr - creatinine Cys - cystatin C B2M - beta 2 microglobulin BTP - beta-trace protein mGFR - measured GFR eGFR - estimated GFR

Conclusions: GFR estimates based on eGFRcr and eGFRcys are not sufficiently accurate in patients with cancer and sarcopenia. Body composition analysis can identify patients in need of more accurate GFR assessment

Verônica Costa e Silva, Meghan Sise, Lesley Inker et. al. *Impact of CT-derived Body Composition Analysis on the Performance of GFR Estimating Equations in Patients with Cancer.* 2025, CJASN, DOI: 10.2215/CJN.0000000878
Visual Abstract by Carlo Trinidad, MD

Combined eGFR creatinine–cystatin C performs better in patients with cancer and sarcopenia compared to eGFRcr and eGFRcys

Role of measured GFR in patients with cancer

- Even the best GFR estimating equations remain indirect measures of kidney function and may be inaccurate in patients with cancer due to non-GFR determinants of creatinine and cystatin-C
- Measured GFR remains the reference standard when treatment decisions depend on precise kidney function
 - borderline cisplatin eligibility
 - carboplatin dosing
 - clinical trial enrollment
 - suspected pseudo-AKI

Table 2-1. Exogenous Markers and Methods Used to Measure GFR (mGFR)

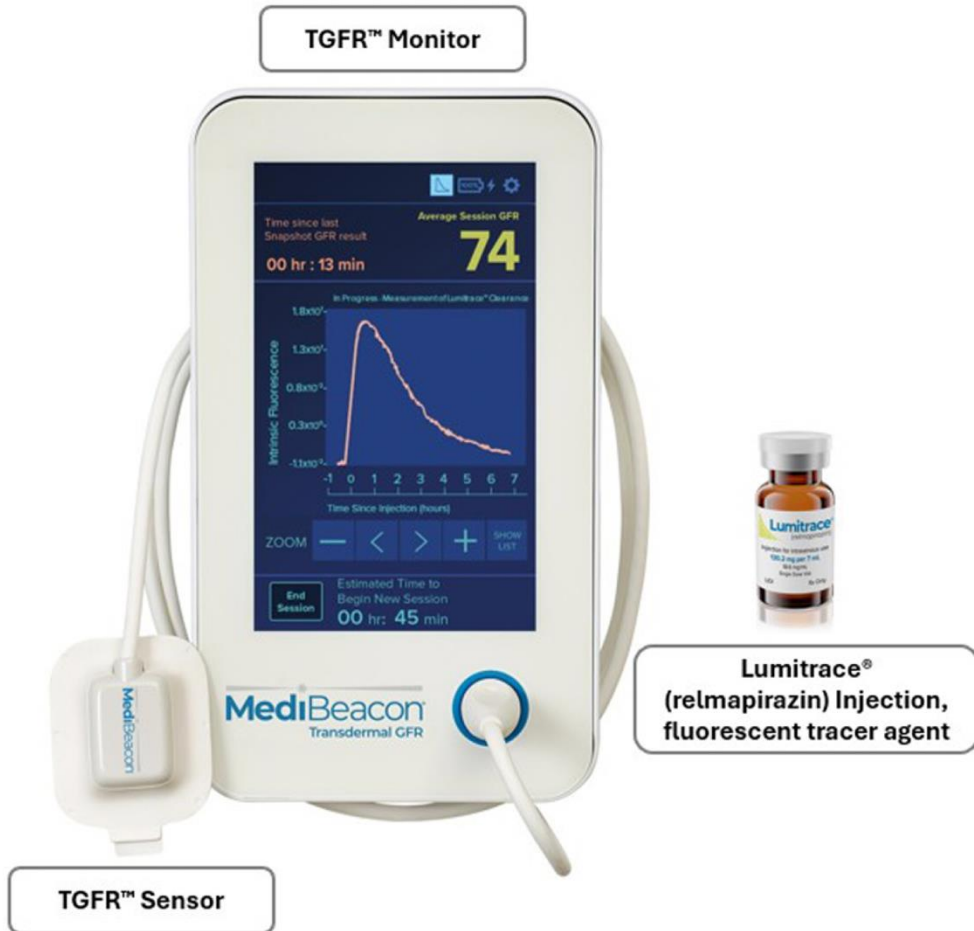
Marker / Method	Clearance Type	Brief Description	Key Strengths	Key Limitations	Current Role
 Inulin	Urinary ± plasma	Gold-standard freely filtered polysaccharide	Closest approximation of true GFR	Labor-intensive; limited availability; assay variability	Research reference standard
 Iothalamate	Urinary ± plasma	Radiocontrast agent cleared by filtration	Accurate across wide GFR range; usable at low GFR	Possible tubular secretion; extra-renal clearance	Clinical and research mGFR
 Iohexol (plasma clearance)	Plasma disappearance	Nonionic contrast with compartment modeling	Non-radioactive; validated; endorsed by EKFC	Multiple blood draws; modeling assumptions	Preferred clinical mGFR in many centers
 Iohexol (continuous infusion)	Plasma (real-time)	Low-dose infusion enabling dynamic GFR tracking	Detects acute changes; superior to creatinine in AKI	Specialized protocols; limited availability	AKI, ICU, perioperative research
 51Cr-EDTA	Urinary or plasma	Radiolabeled chelate	High accuracy; minimal tubular handling	Not FDA-approved; unavailable in U.S.	Europe-based clinical standard
 99mTc-DTPA	Urinary ± plasma	Nuclear medicine tracer	Allows split renal function	Protein binding; tubular reabsorption	Nuclear medicine studies
 FITC-sinistrin (transcutaneous)	Plasma (fluorescence)	Fluorescent inulin analog	Non-invasive trending; real-time	Overestimates low GFR; immunogenicity; cost	Preclinical and large-animal research
 Visible Fluorescent Injectate (VFI)	Plasma (ratiometric)	Dual-dextran fluorescence method	Rapid measurement; motion correction	Still requires blood sampling	Early human trials
 Relmapirazin (MB-102)	Plasma + transcutaneous	Hydrophilic fluorescent tracer with wearable sensor	FDA-approved; bedside, real-time GFR; minimal protein binding	Limited long-term clinical experience	Point-of-care GFR; AKI, CKD, CRRT
 Near-infrared dyes	Plasma (fluorescence)	Experimental NIR tracers	Deep tissue penetration; low autofluorescence	Not validated in humans	Preclinical development

Abbreviations: AKI, acute kidney injury; CKD, chronic kidney disease; CRRT, continuous renal replacement therapy; EKFC, European Kidney Function Consortium; FDA, U.S. Food and Drug Administration; ICU, intensive care unit; mGFR, measured glomerular filtration rate; NIR, near-infrared.

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Point-of-care transdermal GFR



- The tGFR detection system : Fluorescent tracer agent, Lumitrace (relmapirazin), sensor and display monitor
- Relmapirazin is a non-radioactive, non-iodinated fluorescent GFR tracer
- Relmapirazin is injected and the system records its fluorescence intensity transdermally as a function of time via a sensor placed on the skin
- TGFR Monitor displays the average session tGFR reading

Point-of-care Transdermal GFR clinical trial

- Prospective, multicenter trial
- 182 adult participants with kidney function ranging from normal to CKD stage 4
- Transdermal GFR (tGFR) compared to reference plasma-derived indexed GFR (nGFR)
- Included all Fitzpatrick skin types (I–VI)

Table 5. tGFR P₃₀ comparison with the eGFR P₃₀ values in the literature

Methodology	P ₃₀ (%)	95% confidence interval
tGFR	94.0	89.4–96.9
eGFR equations		
CKD-EPI 2009 ¹³	84.1	83.0–85.3
CKD-EPI 2021 ¹⁴	79.2	78.5–79.9
EKFC _{PS} ¹⁴	81.1	80.5–81.8
EKFC _{RF} ¹⁴	80.1	79.4–80.7

CKD-EPI, Chronic Kidney Disease-Epidemiology Collaboration; EKFC_{PS}, European Kidney Function Consortium population-specific Q values; EKFC_{RF}, European Kidney Function Consortium race-free Q values; P₃₀, percentage of tGFR values within 30% of indexed plasma glomerular filtration rate; tGFR, transdermal glomerular filtration rate.

Finding	Result
Primary endpoint achieved	P30 = 94% (95% CI 89.4–96.9%)
Correlation with measured GFR	R ² = 0.84
Performance in CKD	P30 96% (>60), 92% (<60 ml/min/1.73m ²)
Safety	Excellent tolerability; no serious device-related adverse events

Conclusions

- GFR assessment is fundamental to Onco-nephrology
- Estimating GFR equations are better than CG-CrCl but have limitations in patients with cancer
- The future of precision oncology may require precision measurement of kidney function, not simply better estimation

Thank You

Questions & Discussion

