

Overview

Useful For

Estimation of glomerular filtration rate

Profile Information

Test ID	Reporting Name	Available Separately	Always Performed
CRTS1	Creatinine with eGFR, S	Yes	Yes
CRCU	Creatinine, U	No	Yes

Special Instructions

- [Urine Preservatives-Collection and Transportation for 24-Hour Urine Specimens](#)

Method Name

Enzymatic Colorimetric Assay

NY State Available

Yes

Specimen

Specimen Type

Serum

Urine

Necessary Information

- 24-Hour volume is required.
- Patient's height in centimeters and weight in kilograms are required.

Specimen Required

Both serum and urine are required. Serum must be collected no earlier than 24 hours before start of urine collection and no later than 24 hours after urine collection is completed.

Specimen Type: Serum

Container/Tube: Red top or serum gel

Specimen Volume: 1 mL

Collection Instructions: Label specimen as serum.

Specimen Type: Urine

Supplies: Aliquot Tube, 5 mL (T465)

Specimen Volume: 5 mL

Collection Instructions:

1. Collect urine for 24 hours.
2. Refrigerate specimen within 4 hours of completion of 24-hour collection.
3. Label specimen as urine.

Additional Information: See [Urine Preservatives-Collection and Transportation for 24-Hour Urine Specimens](#) in Special Instructions for multiple collections.

Forms

If not ordering electronically, complete, print, and send a [Renal Diagnostics Test Request](#) (T830) with the specimen.

Urine Preservative Collection Options

Note: The addition of preservative or application of temperature controls **must occur within 4 hours of completion** of the collection.

Ambient	Preferred
Refrigerate	OK
Frozen	OK
50% Acetic Acid	OK
Boric Acid	OK
Diazolidinyl Urea	OK
6M Hydrochloric Acid	OK
6M Nitric Acid	OK
Sodium Carbonate	OK
Thymol	OK
Toluene	No

Specimen Minimum Volume

Serum: 0.5 mL
Urine: 1 mL

Reject Due To

Gross hemolysis	Reject
Gross lipemia	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Serum	Refrigerated (preferred)		
	Frozen		
Urine	Refrigerated (preferred)		
	Ambient		
	Frozen		

Clinical and Interpretive

Clinical Information

Estimated GFR Using Serum Creatinine Alone:

Estimated glomerular filtration rate (eGFR) is calculated using the 2009 CKD Epidemiology Collaboration (CKD-EPI) equation:

$eGFR(CKD-EPI) = 141 \times \min(Scr/k, 1)^\alpha \times \max(Scr/k, 1)^{-1.209} \times 0.993^{\text{age}} \times 1.018$ (if patient is female) $\times 1.159$ (if patient is black)

-where age is in years

-k is 0.7 for females and 0.9 for males

-alpha is -0.329 for females and -0.411 for males

-min indicates the minimum of Scr/k or 1

-max indicates the maximum of Scr/k or 1

Use of an estimating or prediction equation to estimate GFR from serum creatinine should be employed for people with chronic kidney disease (CKD) and those with risk factors for CKD (diabetes, hypertension, cardiovascular disease, and family history of kidney disease). Reasons given for routine reporting of eGFR with every serum creatinine in adult (18 and over) patients include:

-GFR and creatinine clearance are poorly inferred from serum creatinine alone. GFR and creatinine clearance are inversely and nonlinearly related to serum creatinine. The effects of age, sex, and, to a lesser extent, race, on creatinine production further cloud interpretation.

-Creatinine is commonly measured in routine clinical practice. Albuminuria (>30 mg/24 hour or urine albumin to creatinine ratio >30 mg/g) may be a more sensitive marker of early renal disease, especially among patients with diabetic nephropathy. However, there is poor adherence to guidelines that suggest annual urinary albumin testing of patients with known diabetes. Therefore, if a depressed eGFR is calculated from a serum creatinine measurement, it may help providers recognize early CKD and pursue appropriate follow-up testing and therapeutic intervention.

-Monitoring of kidney function (by GFR or creatinine clearance) is essential once albuminuria is discovered. Estimated GFR is a more practical means to closely follow changes in GFR over time, when compared to direct

measurement using methods such as iothalamate clearance.

-The CKD-EPI equation does not require weight or height variables. From a serum creatinine measurement, it generates a GFR result normalized to a standard body surface area (1.73 m²) using sex, age, and race. Unlike the Cockcroft-Gault equation, height and weight, which are often not available in the laboratory information system, are not required. The CKD-EPI equation does require race (African American or non-African American), which also may not be readily available. For this reason, eGFR values for both African Americans and non-African Americans are reported. The difference between the 2 estimates is typically about 20%. The patient or provider can decide which result is appropriate for a given patient.

The Kidney Disease: Improving Global Outcomes (KDIGO) CKD work group clinical practice guidelines,(1) as further defined by the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative (NKF-KDOQI) commentary,(2) provide the following recommendations for reporting and interpretation of serum creatinine and eGFR:

1.4.3: Evaluation of GFR

-1.4.3.1: We recommend using serum creatinine and a GFR estimating equation for initial assessment.

-1.4.3.2: We suggest using additional tests (such as cystatin C or a clearance measurement) for confirmatory testing in specific circumstances when eGFR based on serum creatinine is less accurate. (2B)

-1.4.3.3: We recommend that clinicians:

--Use a GFR estimating equation to derive GFR from serum creatinine (eGFR_{creat}) rather than relying on the serum creatinine concentration alone.

--Understand clinical settings in which eGFR_{creat} is less accurate.

-1.4.3.4: We recommend that clinical laboratories should:

--Measure serum creatinine using a specific assay with calibration traceable to the international standard reference materials and minimal bias compared to isotope-dilution mass spectrometry (IDMS) reference methodology.

--Report eGFR_{creat} in addition to the serum creatinine concentration in adults and specify the equation used whenever reporting eGFR_{creat}.

--Report eGFR_{creat} in adults using the 2009 CKD-EPI creatinine equation. An alternative creatinine-based GFR estimating equation is acceptable if it has been shown to improve accuracy of GFR estimates compared to the 2009 CKD-EPI creatinine equation.

When reporting serum creatinine:

-We recommend that serum creatinine concentration be reported and rounded to the nearest whole number when expressed as standard international units (mmol/L) and rounded to the nearest 100th of a whole number when expressed as conventional units (mg/dL).

When reporting eGFR_{creat}:

-We recommend that eGFR_{creat} should be reported and rounded to the nearest whole number and relative to a body surface area of 1.73 m² in adults using the units mL/min/1.73 m².

-We recommend eGFR_{creat} levels less than 60 mL/min/1.73 m² should be reported as "decreased".

1.4.3.8: We suggest measuring GFR using an exogenous filtration marker under circumstances where more accurate ascertainment of GFR will impact treatment decisions

Creatinine Clearance:

Creatinine is derived from the metabolism of creatine from skeletal muscle and dietary meat intake, and is released into the circulation at a relatively constant rate. Thus, the serum creatinine concentration is usually stable. Creatinine is freely filtered by glomeruli and not reabsorbed or metabolized by renal tubules. Therefore, creatinine clearance can be used to assess GFR. However, approximately 15% of excreted urine creatinine is derived from proximal tubular secretion. Because of the tubular secretion of creatinine, creatinine clearance typically overestimates true GFR by 10% to 15%.

Creatinine clearance is usually determined from measurement of creatinine in a 24-hour urine specimen and from a serum specimen obtained during the same collection period. However, shorter time periods can be used. A key consideration is accurate timing and collection of the urine sample. Creatinine clearance normalized to body surface area is calculated by the equation:

$$2.54 \text{ cm} = 1 \text{ inch}$$

$$1 \text{ kg} = 2.2 \text{ pounds (lbs)}$$

$$\text{Patient surface area (SA)} = \text{wt (kg)}(0.425) \times \text{ht (cm)}(0.725) \times 0.007184$$

	Urine conc (mg/dL) x 24 hr urine volume (mL)		
Uncorr creat clear=		1440 minutes	
mL/min	Serum creat (mg/dL)		
	Urine conc (mg/dL) x 24 hr urine volume (mL)	X	
Corr creat clear=		1440 minutes	1.73 m ²
mL/min/1.73m ²	Serum creat (mg/dL)		Patient SA

Reference Values

CREATININE CLEARANCE

Males:

0-18 years: Reference values have not been established

19-75 years: 77-160 mL/min/BSA

> or =76 years: Reference values have not been established

Females:

0-17 years: Reference values have not been established

18-29 years: 78-161 mL/min/BSA

30-39 years: 72-154 mL/min/BSA

40-49 years: 67-146 mL/min/BSA

50-59 years: 62-139 mL/min/BSA

60-72 years: 56-131 mL/min/BSA

> or =73 years: Reference values have not been established

CREATININE, URINE:

Reported in units of mg/dL

CREATININE, SERUM

Males:

0-11 months: 0.17-0.42 mg/dL

1-5 years: 0.19-0.49 mg/dL

6-10 years: 0.26-0.61 mg/dL

11-14 years: 0.35-0.86 mg/dL

> or =15 years: 0.74-1.35 mg/dL

Females:

0-11 months: 0.17-0.42 mg/dL

1-5 years: 0.19-0.49 mg/dL

6-10 years: 0.26-0.61 mg/dL

11-15 years: 0.35-0.86 mg/dL

> or =16 years: 0.59-1.04 mg/dL

eGFR

> or =60 mL/min/BSA

Estimated GFR calculated using the 2009 CKD_EPI creatinine equation

Interpretation

Decreased creatinine clearance indicates decreased glomerular filtration rate (GFR). This can be due to conditions such as progressive renal disease, or result from adverse effect on renal hemodynamics that are often reversible, including drug effects or decreases in effective renal perfusion (eg, volume depletion, heart failure).

Increased creatinine clearance is often referred to as hyperfiltration and is most commonly seen during pregnancy or in patients with early diabetes mellitus, before diabetic nephropathy has occurred. It may also occur with large dietary protein intake.

A major limitation of creatinine clearance is that its accuracy worsens in relation to the amount of tubular creatinine secretion. Often as GFR declines, the contribution of urine creatinine from tubular secretion increases, further increasing the discrepancy between true GFR and measured creatinine clearance.

Estimated GFR:

According to the Kidney Disease: Improving Global Outcomes (KDIGO) CKD work group, chronic kidney disease (CKD) is defined as the abnormalities of kidney structure or function, present for more than 3 months, with implications for health.(1,2) CKD should be classified by cause, GFR category, and albuminuria category.(1,2)

KDIGO guidelines provide the following GFR categories(1,2):

Stage	Terms	GFR mL/min/1.73 m(2)
G1*	Normal or high	90
G2*	Mildly decreased	60 to 89
G3a	Mildly to moderately decreased	45 to 59
G3b	Moderately to severely decreased	30-44
G4	Severely decreased	15-29
G5	Kidney failure	<15

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

Urinary albumin excretion can also be used to further subdivide CKD stages.

Cautions

One of the major limitations of creatinine clearance is erroneous results due to incomplete urine collections. Accurate results depend upon a complete and accurately timed collection.

Result can be falsely decreased in patients with elevated levels of N-acetyl-p-benzoquinone imine (NAPQI, a metabolite of acetaminophen), N-acetylcysteine (NAC), and Metamizole.

Clinical Reference

1. Inker LA, Astor BC, Fox CH, et al: KDOQI US commentary on the 2012 KDIGO clinical practice guideline for the evaluation and management of CKD. Am J Kidney Dis. 2014 May;63(5):713-35. doi: 10.1053/j.ajkd.2014.01.416

2. National Kidney Foundation. KDOQI Clinical Practice Guideline for Diabetes and CKD: 2012 Update. Am J Kidney Dis. 2012 Nov;60(5):850-86. doi:10.1053/j.ajkd.2012.07.005. Erratum in: Am J Kidney Dis. 2013 Jun;61(6):1049
3. Post TW, Rose BD: Assessment of renal function: plasma creatinine; BUN; and GFR. In Up To Date 9.1. Edited by BD Rose. 2001
4. Kasiske BL, Keane WF: Laboratory assessment of renal disease: clearance, urinalysis, and renal biopsy. In The Kidney. Sixth edition. Edited by BM Brenner. WB Saunders Company, 2000, pp 1129-1170
5. Delaney MP, Lamb EJ: Chapter 59: Kidney Disease. In Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. Sixth edition. Edited by N Rifai, AR Horvath, CT Wittwer. Elsevier, 2018, pp 1256-1323

Performance

Method Description

The enzymatic method is based on the determination of sarcosine from creatinine with the aid of creatininase, creatinase, and sarcosine oxidase. The liberated hydrogen peroxide is measured via a modified Trinder reaction using a colorimetric indicator. Optimization of the buffer system and the colorimetric indicator enables the creatinine concentration to be quantified both precisely and specifically. (Package insert: Roche Diagnostics, Indianapolis IN, 2004)

PDF Report

No

Day(s) Performed

Monday through Sunday

Report Available

Same day/1 to 2 days

Specimen Retention Time

7 days

Performing Laboratory Location

Rochester

Fees and Codes

Fees

- Authorized users can sign in to [Test Prices](#) for detailed fee information.
- Clients without access to Test Prices can contact [Customer Service](#) 24 hours a day, seven days a week.
- Prospective clients should contact their Regional Manager. For assistance, contact [Customer Service](#).

Test Classification

This test has been cleared, approved or is exempt by the U.S. Food and Drug Administration and is used per manufacturer's instructions. Performance characteristics were verified by Mayo Clinic in a manner consistent with CLIA requirements.

CPT Code Information

82575

LOINC® Information

Test ID	Test Order Name	Order LOINC Value
CRCL	Creatinine Clearance	58446-6

Result ID	Test Result Name	Result LOINC Value
CRTSA	Creatinine, S	2160-0
EGNB	eGFR-Non Black	88294-4
EGBL	eGFR-Black	88293-6
CRE_U	Creatinine, U	20624-3
TM54	Time	13362-9
VL52	Volume	3167-4
CRCL1	Creatinine Clearance	12195-4