



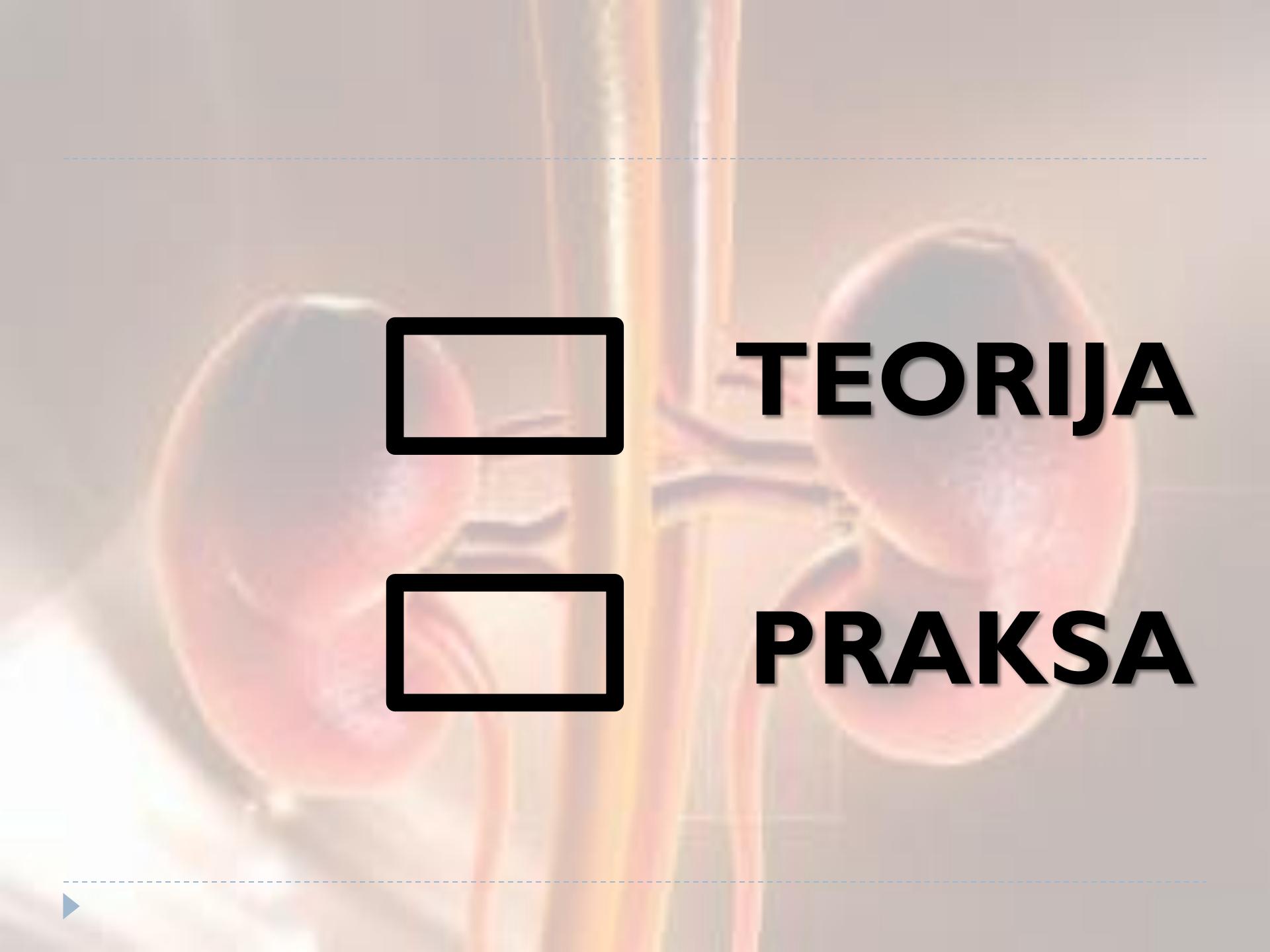
# Procjena glomerularne filtracije - teorija i praksa -

Vanja Radišić Biljak



The Beginning



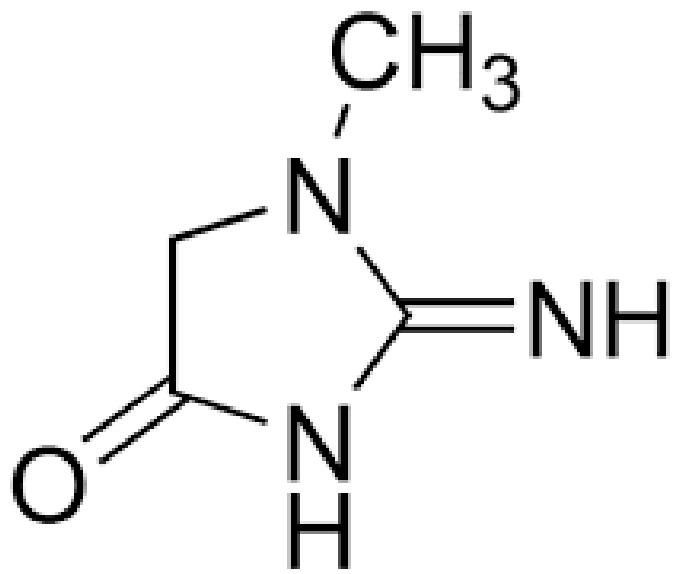
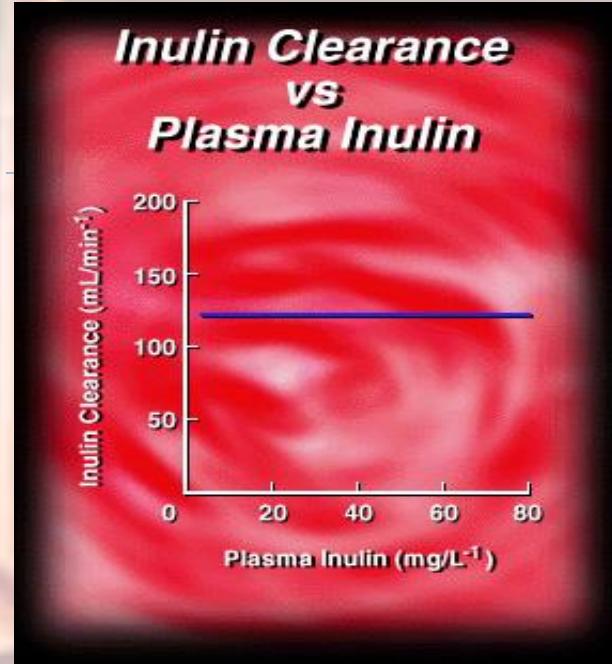
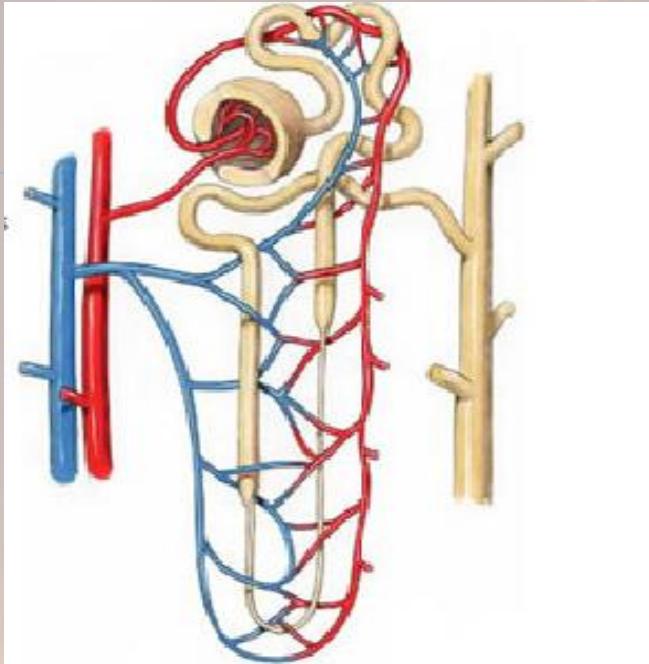


**TEORIJA**



**PRAKSA**







## Original papers

### Low level of adherence to instructions for 24-hour urine collection among hospital outpatients

Marijana Miler\*, Ana-Maria Šimundić

University Department of Chemistry, Medical School University Hospital Sestre Milosrdnice, Zagreb, Croatia

\*Corresponding author: marijana.miler@gmail.com

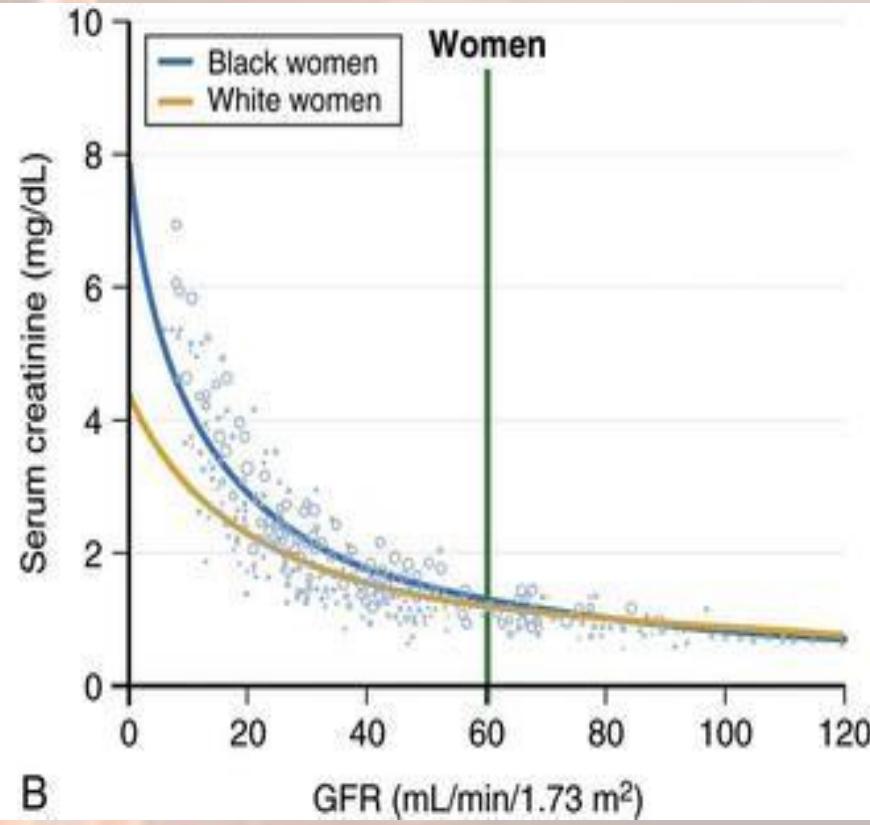
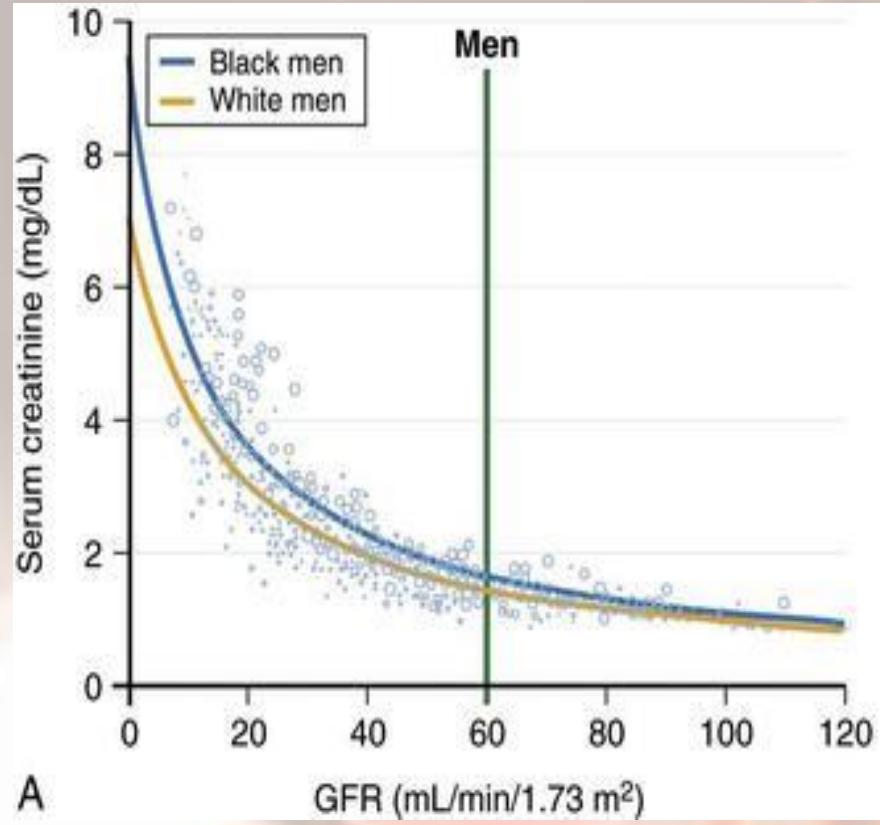
The screenshot shows a web page from Mayo Clinic Mayo Medical Laboratories. At the top left is the Mayo Clinic logo and the text "MAYO CLINIC Mayo Medical Laboratories". Below the logo is a navigation bar with a "Home" link. On the left, there is a sidebar titled "Test Catalog" with a search bar and a "Go" button. Below the search bar are tabs for "Test Name" and "Disease". To the right of the sidebar, there are links for "PRINT PAGE" and "EMAIL PAGE". The main content area has a large title "Test ID: CRC" and a subtitle "Creatinine Clearance, Serum and 24-Hour Urine".

#### 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.

Key

Requires Registration



## **Prediction of Creatinine Clearance from Serum Creatinine**

Donald W. Cockcroft, Henry Gault

Departments of Medicine, Queen Mary Veterans' Hospital, Montreal, Quebec, and Memorial University, St. John's, Newfoundland

### Address of Corresponding Author

*Nephron* 1976;16:31-41 (DOI: 10.1159/000180580)

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16 March 1999

Volume 130

Number 6

## **Annals of Internal Medicine**

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### **A More Accurate Method To Estimate Glomerular Filtration Rate from Serum Creatinine: A New Prediction Equation**

Andrew S. Levey, MD; Juan P. Bosch, MD; Julia Breyer Lewis, MD; Tom Greene, PhD; Nancy Rogers, MS; and David Roth, MD, for the Modification of Diet in Renal Disease Study Group\*



Published in final edited form as:

*Ann Intern Med.* 2009 May 5; 150(9): 604–612.

## A New Equation to Estimate Glomerular Filtration Rate

Andrew S. Levey, MD<sup>1</sup>, Lesley A. Stevens, MD, MS, FRCP(C)<sup>1</sup>, Christopher H. Schmid, PhD<sup>1</sup>, Yaping (Lucy) Zhang, MS<sup>1</sup>, Alejandro F. Castro III, MPH<sup>2</sup>, Harold I. Feldman, MD, MSCE<sup>3</sup>, John W. Kusek, PhD<sup>4</sup>, Paul Eggers, PhD<sup>4</sup>, Frederick Van Lente, PhD<sup>5</sup>, Tom Greene, PhD<sup>6</sup>, and Josef Coresh, MD, PhD, MHS<sup>2</sup> for the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI)<sup>7</sup>

### A Simple Estimate of Glomerular Filtration Rate in Children Derived From Body Length and Plasma Creatinine

G. J. Schwartz, G. B. Haycock, C. M. Edelmann, Jr. and Adrian Spitzer  
*Pediatrics* 1976;58:259

# Summary of Recommendation Statements

*Kidney International Supplements (2013) 3, 5–14; doi:10.1038/kisup.2012.77*

## Chapter 1: Definition and classification of CKD

### 1.1: DEFINITION OF CKD

1.1.1: CKD is defined as abnormalities of kidney structure or function, present for >3 months, with implications for health. (*Not Graded*)

#### Criteria for CKD (either of the following present for >3 months)

Markers of kidney damage (one or more)	Albuminuria (AER $\geq 30 \text{ mg}/24 \text{ hours}$ ; ACR $\geq 30 \text{ mg/g}$ [ $\geq 3 \text{ mg}/\text{mmol}$ ]) Urine sediment abnormalities Electrolyte and other abnormalities due to tubular disorders Abnormalities detected by histology Structural abnormalities detected by imaging History of kidney transplantation
Decreased GFR	GFR $< 60 \text{ mL/min}/1.73 \text{ m}^2$ (GFR categories G1a–G5)

Abbreviations: CKD, chronic kidney disease; GFR, glomerular filtration rate.





## 9. Microvascular Complications and Foot Care

American Diabetes Association

*Diabetes Care* 2015;38(Suppl. 1):S58–S66 | DOI: 10.2337/dc15-S012

### NEPHROPATHY

#### Recommendations

- Optimize glucose control to reduce the risk or slow the progression of diabetic kidney disease. **A**
- Optimize blood pressure control to reduce the risk or slow the progression of diabetic kidney disease. **A**

#### Screening

- At least once a year, quantitatively assess urinary albumin (e.g., urine albumin-to-creatinine ratio [UACR]) and estimated glomerular filtration rate (eGFR) in patients with type 1 diabetes duration of  $\geq 5$  years and in all patients with type 2 diabetes. **B**

Improving the understanding, detection, and management of kidney disease.

[Home](#)[Learn About Kidney Disease](#)[Living with Kidney Disease](#)[Identify and Manage Patients](#)[Laboratory Evaluation](#)[Get Involved](#)[Federal Response to CKD](#)[Resource Center](#)[NEWSLETTER SIGNUP](#)[SEARCH](#)

[Home](#) › [Learn About Kidney Disease](#) › [Testing for Kidney Disease](#) › [Understanding GFR](#)

## LEARN ABOUT KIDNEY DISEASE ›

[Kidney Disease Basics](#)[At Risk for Kidney Disease?](#)[Keep Your Kidneys Healthy](#)[Testing for Kidney Disease](#)[Children and Kidney Disease](#)[Additional Kidney Information](#)

## Understanding GFR

GFR stands for glomerular (glow-MAIR-you-lure) filtration rate. A blood test checks your GFR, which tells how well your kidneys are filtering.

It's important to know your GFR if you are at risk for kidney disease. A urine test will also be used to check your kidneys.

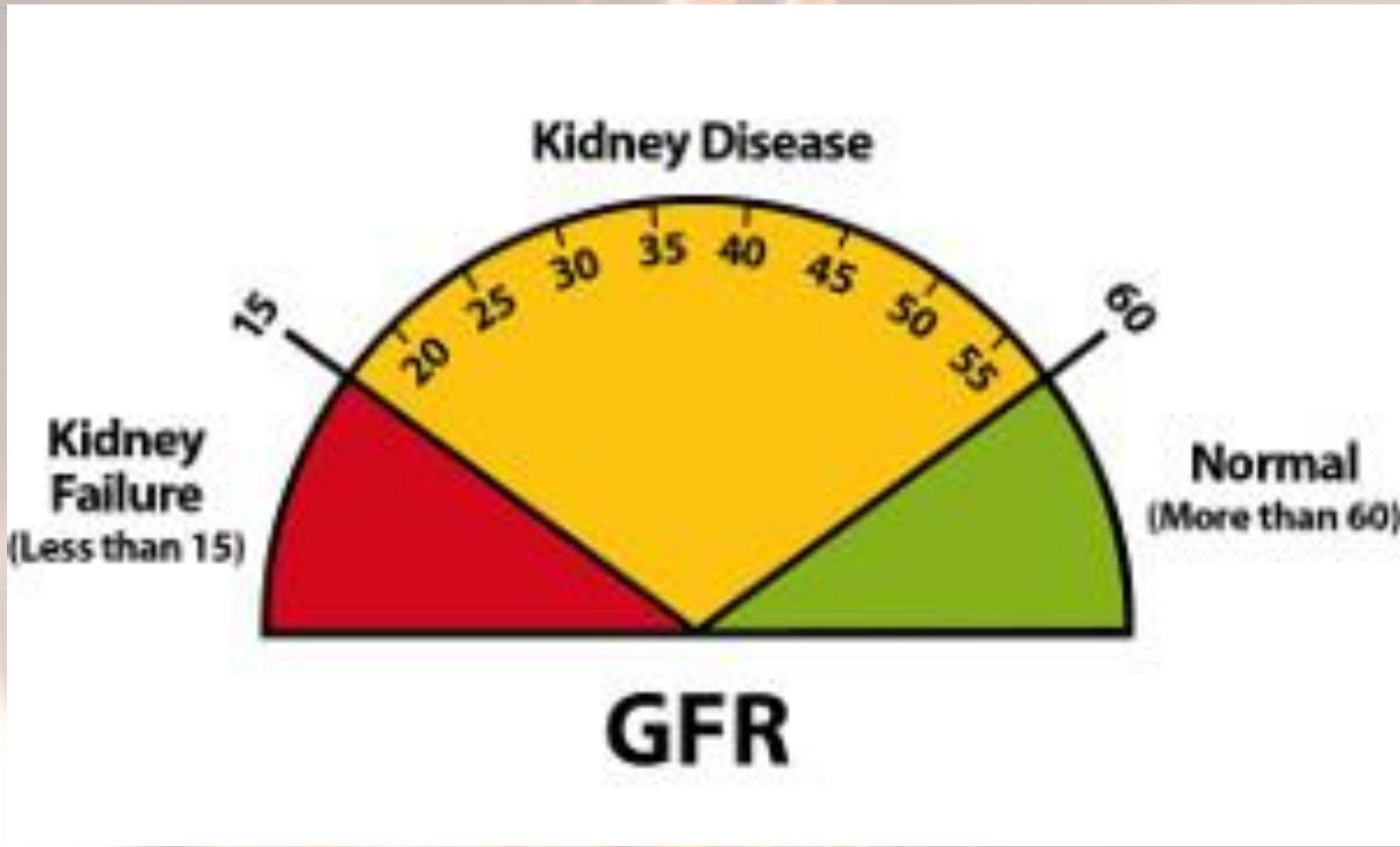
GFR is reported as a number.

- A **GFR of 60 or higher** is in the normal range.
- A **GFR below 60** may mean you have kidney disease.
- A **GFR of 15 or lower** may mean kidney failure.

### TESTING FOR KIDNEY DISEASE

[Overview](#)[Understanding GFR](#)[Understanding Urine Albumin](#)

Learn about living with kidney disease  
[Read More ›](#)









**TEORIJA**



**PRAKSA**



## CKD-EPI

muškarci:

ukoliko je konc. kreatinina u serumu  $\leq 79,6$ :  $141^{\alpha} \times (\text{kreatinin u serumu}/79,6)^{-0,411} \times (0,993)^{\text{dob}}$   
ukoliko je konc. kreatinina u serumu  $> 79,6$ :  $141^{\alpha} \times (\text{kreatinin u serumu}/79,6)^{-1,209} \times (0,993)^{\text{dob}}$

žene:

ukoliko je konc. kreatinina u serumu  $\leq 61,9$ :  $144^{\alpha} \times (\text{kreatinin u serumu}/61,9)^{-0,329} \times (0,993)^{\text{dob}}$   
ukoliko je konc. kreatinina u serumu  $> 61,9$ :  $144^{\alpha} \times (\text{kreatinin u serumu}/61,9)^{-1,209} \times (0,993)^{\text{dob}}$

kreatinin u serumu:  $\mu\text{mol/L}$ , dob: godine

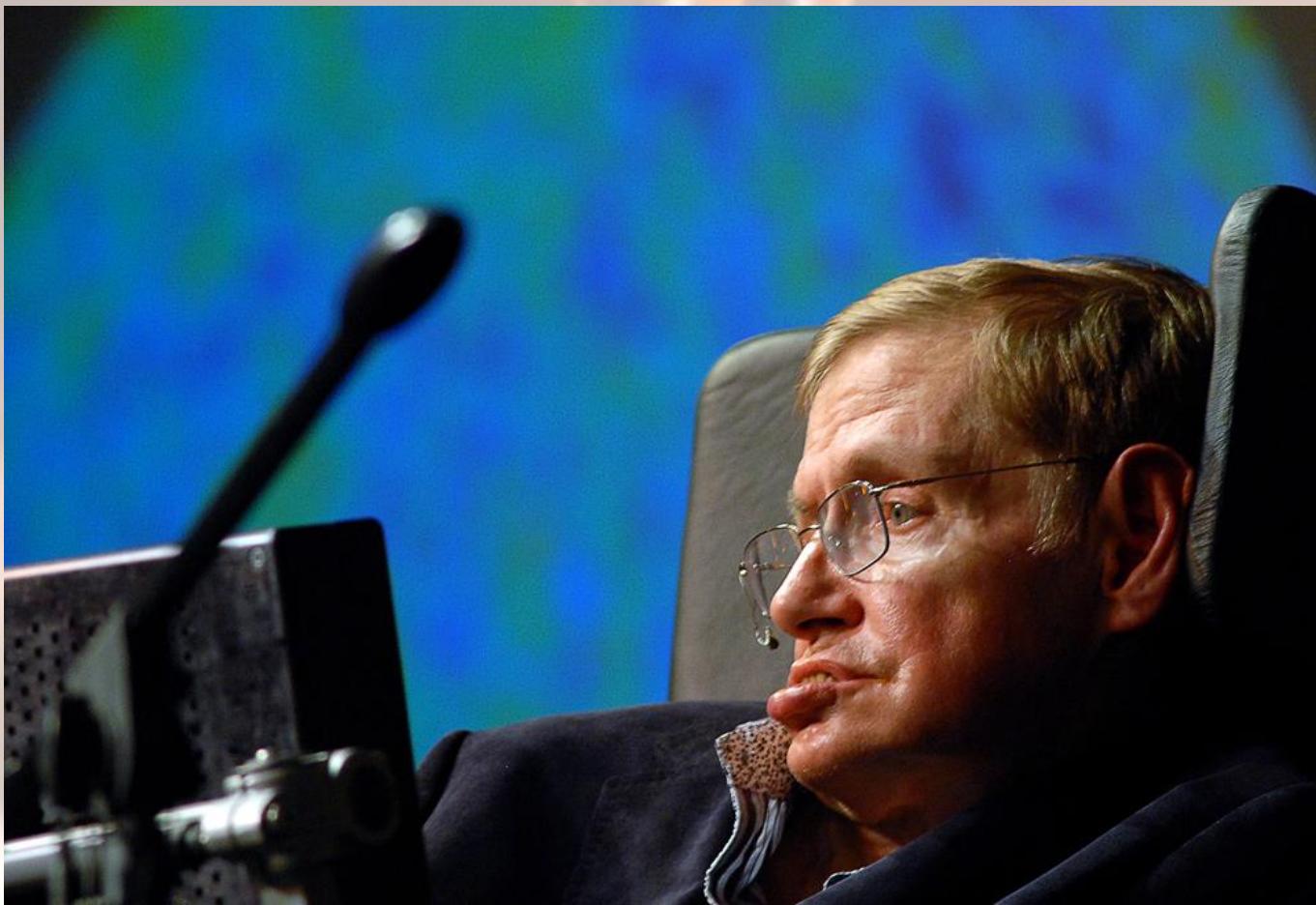
korekcijski faktor za rasu: za crnačku populaciju, koeficijent  $\alpha$  iznosi 163 za muškarce te 166 za žene

CKD-EPI = Chronic Kidney Disease Epidemiology Collaboration









## TESTNA PACIJENTICA

Analizom krvi (K), kapilarne (kK), venske (vK), arterijske (aK), plazme (P), seruma (S), urina (U), 24 satnog urina (dU) nađeno je:

### HITNE PRETRAGE

Izradio/la:

Validirao/la: Radišić Biljak V.

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
(S) H-Standardizirani kreatinin*	63	µmol/L	49 - 90	IDMS sljedivost-enzimatska metoda eGFR-CKD-EPI = 110 mL/min/1.73 m <sup>2</sup>

### BIOKEMIJA

Izradio/la:

Pretraga/Analit

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
(S) Standardizirani kreatinin*	83	µmol/L	49 - 90	IDMS sljedivost
(S) Ukupni bilirubin*	618	µmol/L	3 - 20	
(S) L I H	0 4 0			

### FUNKCIONALNI PARAMETRI

Izradio/la:

Pretraga/Analit

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
Procjena glomerularne filtracije (eGFR-CKD-EPI)	79	mL/min/1.73 m <sup>2</sup>	KATEG. GFR G1: >/= 90 G2: 60 - 89 G3a: 45 - 59 G3b: 30 - 44 G4: 15 - 29 G5: <15	KDIGO SMJERNICE (2012.)

## TESTNI BOLESNIK

Analizom krvi (K), kapilarne (kK), venske (vK), arterijske (aK), plazme (P), seruma (S), urina (U), 24 satnog urina (dU) nađeno je:

### HITNE PRETRAGE

Izradio/la:

Validirao/la: Radišić Biljak V.

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
(S) H-Standardizirani kreatinin*	115	µmol/L	49 - 90	IDMS sljedivost-enzimatska metoda eGFR-CKD-EPI = 48 mL/min/ 1.73 m <sup>2</sup>

### BIOKEMIJA

Izradio/la:

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
(S) Standardizirani kreatinin*	131	µmol/L	49 - 90	IDMS sljedivost
(S) Ukupni bilirubin*	379	µmol/L	3 - 20	
(S) L I H	0 3 0			

### FUNKCIONALNI PARAMETRI

Izradio/la:

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
Procjena glomerularne filtracije (eGFR-CKD-EPI)	41	mL/min/ 1.73 m <sup>2</sup>	KATEG. GFR G1: >/= 90 G2: 60 - 89 G3a: 45 - 59 G3b: 30 - 44 G4: 15 - 29 G5: <15	KDIGO SMJERNICE (2012.)

## TESTNI BOLESNIK

Analizom krvi (K), kapilarne (kK), venske (vK), arterijske (aK), plazme (P), seruma (S), urina (U), 24 satnog urina (dU) nađeno je:

### HITNE PRETRAGE

Izradio/la:

Validirao/la: Radišić Biljak V.

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
(S) H-Standardizirani kreatinin*	102	µmol/L	49 - 90	IDMS sljedivost-enzimatska metoda eGFR-CKD-EPI = 56 mL/min/ 1.73 m <sup>2</sup>

### POKAZATELJI GLUKOREGULACIJE

Izradio/la:

Pretraga/Analit

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
(S) Glukoza - nasumična*	87.7	mmol/L		

### BIOKEMIJA

Izradio/la:

Pretraga/Analit

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
(S) Standardizirani kreatinin*	122	µmol/L	49 - 90	IDMS sljedivost

### FUNKCIONALNI PARAMETRI

Izradio/la:

Pretraga/Analit

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
Procjena glomerularne filtracije (eGFR-CKD-EPI)	44	mL/min/ 1.73 m <sup>2</sup>	KATEG. GFR G1: >/= 90 G2: 60 - 89 G3a: 45 - 59 G3b: 30 - 44 G4: 15 - 29 G5: <15	KDIGO SMJERNICE (2012.)

## TESTNI BOLESNIK

Analizom krvi (K), kapilarne (kK), venske (vK), arterijske (aK), plazme (P), seruma (S), urina (U), 24 satnog urina (dU) nadeno je:

### HITNE PRETRAGE

Izradio/la:

Validirao/la: Radišić Biljak V.

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
(S) H-Standardizirani kreatinin*	91	µmol/L	49 - 90	IDMS sljedivost-enzimatska metoda eGFR-CKD-EPI = 64 mL/min/ 1.73 m <sup>2</sup>

### POKAZATELJI GLUKOREGULACIJE

Izradio/la:

Pretraga/Analit

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
(S) Glukoza - nasumična*	26.6	mmol/L		

### BIOKEMIJA

Izradio/la:

Pretraga/Analit

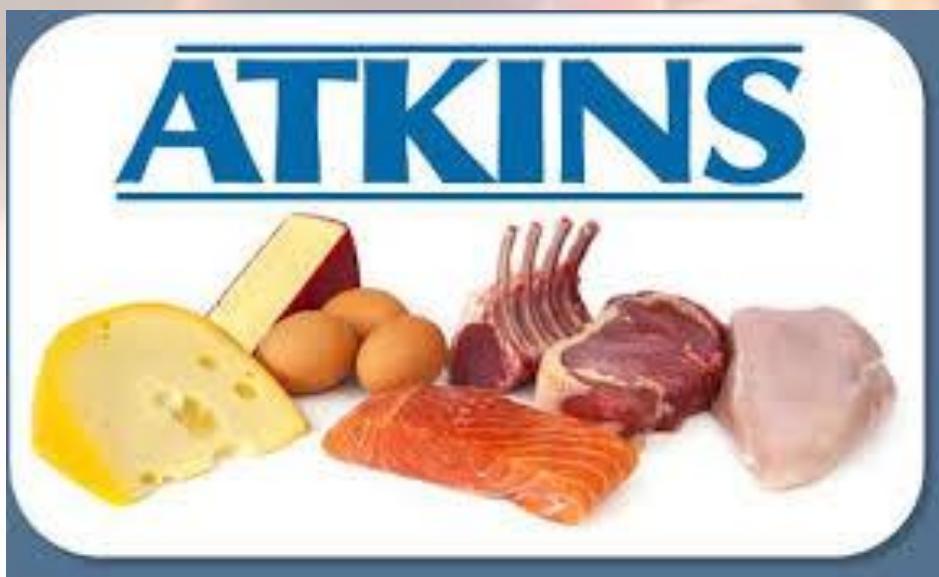
Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
(S) Standardizirani kreatinin*	104	µmol/L	49 - 90	IDMS sljedivost

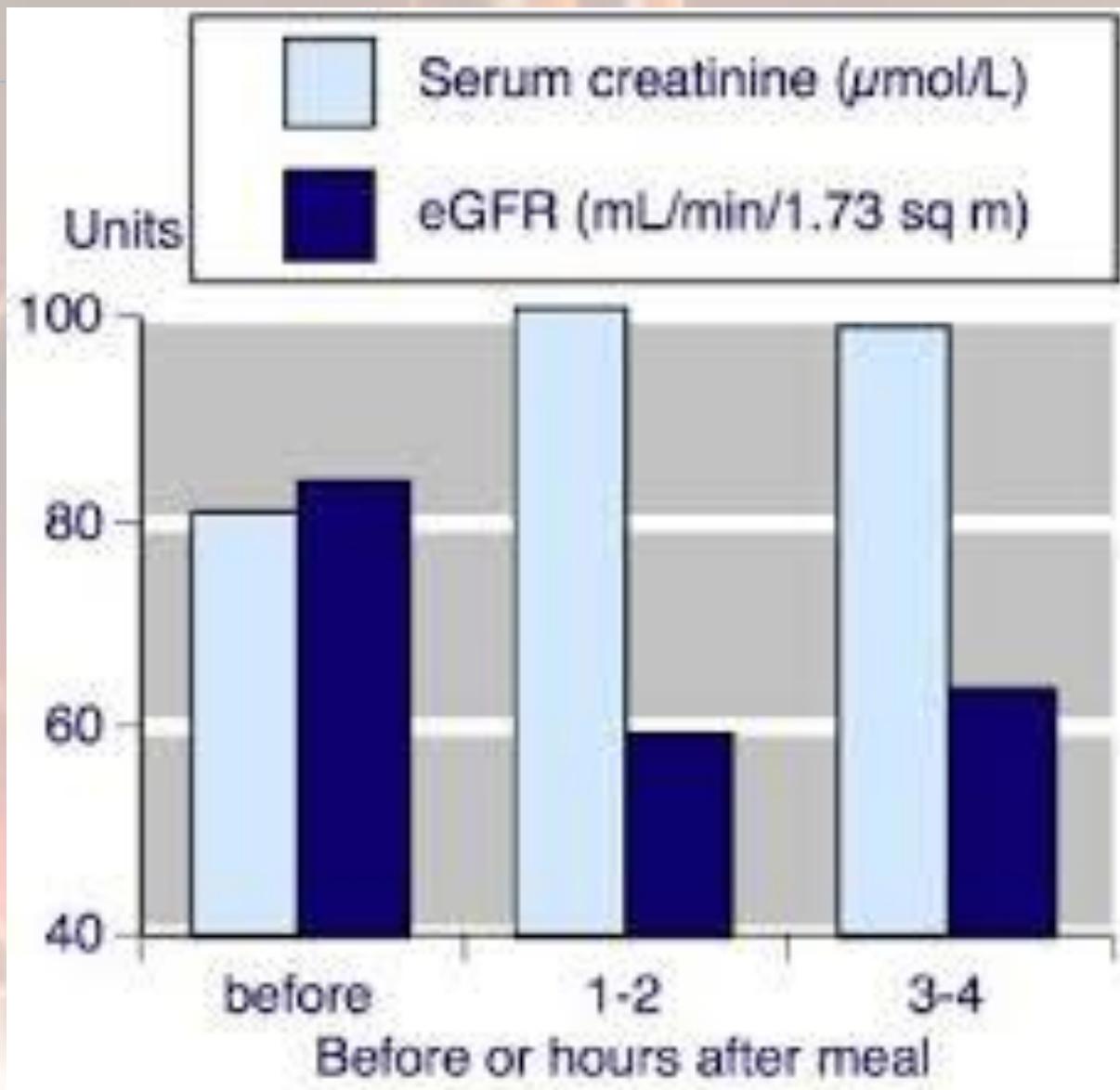
### FUNKCIONALNI PARAMETRI

Izradio/la:

Pretraga/Analit

Pretraga/Analit	Rezultat	Jedinica	Referentni interval	Napomena
Procjena glomerularne filtracije (eGFR-CKD-EPI)	55	mL/min/ 1.73 m <sup>2</sup>	KATEG. GFR G1: >/= 90 G2: 60 - 89 G3a: 45 - 59 G3b: 30 - 44 G4: 15 - 29 G5: <15	KDIGO SMJERNICE (2012.)





## CKD-EPI

muškarci:

ukoliko je konc. kreatinina u serumu  $\leq 79,6$ :  $141^{\alpha} \times (\text{kreatinin u serumu}/79,6)^{-0,411} \times (0,993)^{\text{dob}}$   
ukoliko je konc. kreatinina u serumu  $> 79,6$ :  $141^{\alpha} \times (\text{kreatinin u serumu}/79,6)^{-1,209} \times (0,993)^{\text{dob}}$

žene:

ukoliko je konc. kreatinina u serumu  $\leq 61,9$ :  $144^{\alpha} \times (\text{kreatinin u serumu}/61,9)^{-0,329} \times (0,993)^{\text{dob}}$   
ukoliko je konc. kreatinina u serumu  $> 61,9$ :  $144^{\alpha} \times (\text{kreatinin u serumu}/61,9)^{-1,209} \times (0,993)^{\text{dob}}$

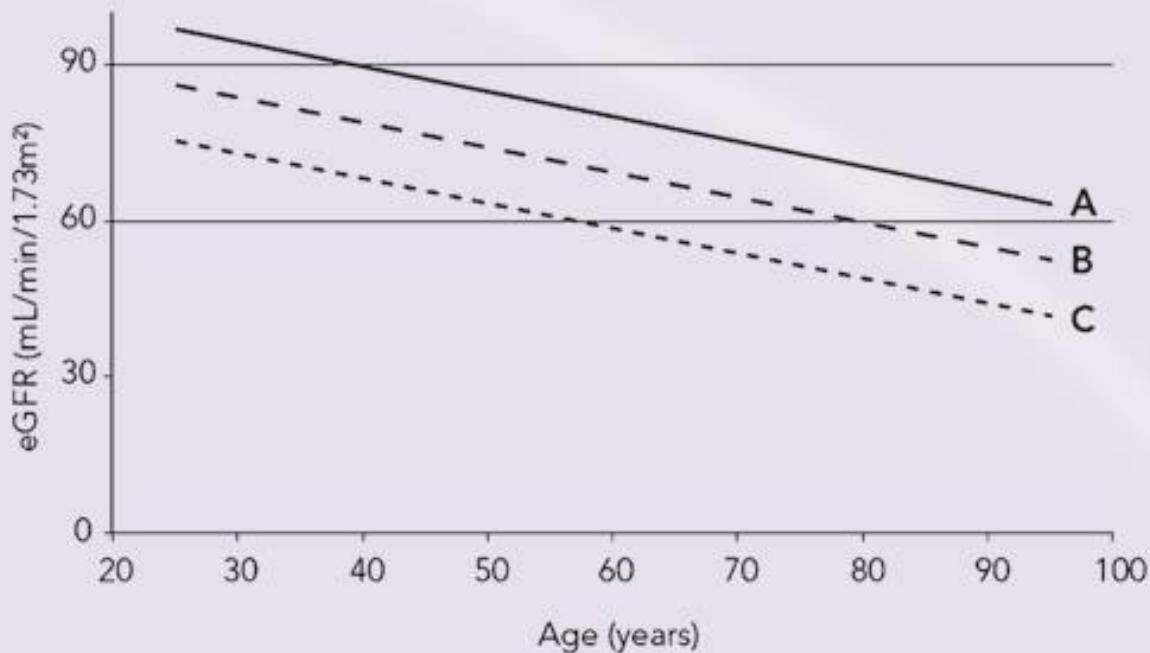
kreatinin u serumu:  $\mu\text{mol/L}$ , dob: godine

korekcijski faktor za rasu: za crnačku populaciju, koeficijent  $\alpha$  iznosi 163 za muškarce te 166 za žene

CKD-EPI = Chronic Kidney Disease Epidemiology Collaboration

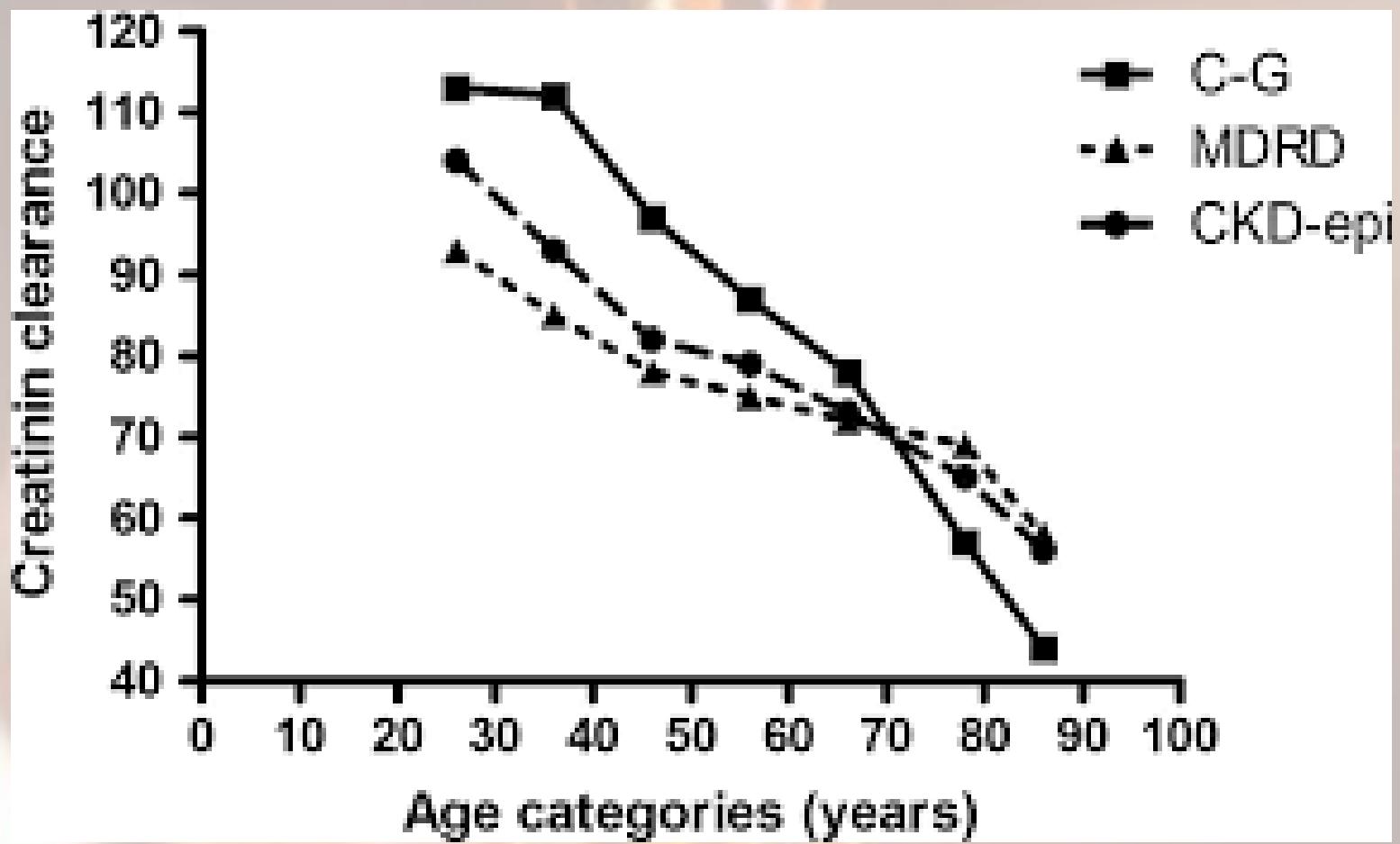


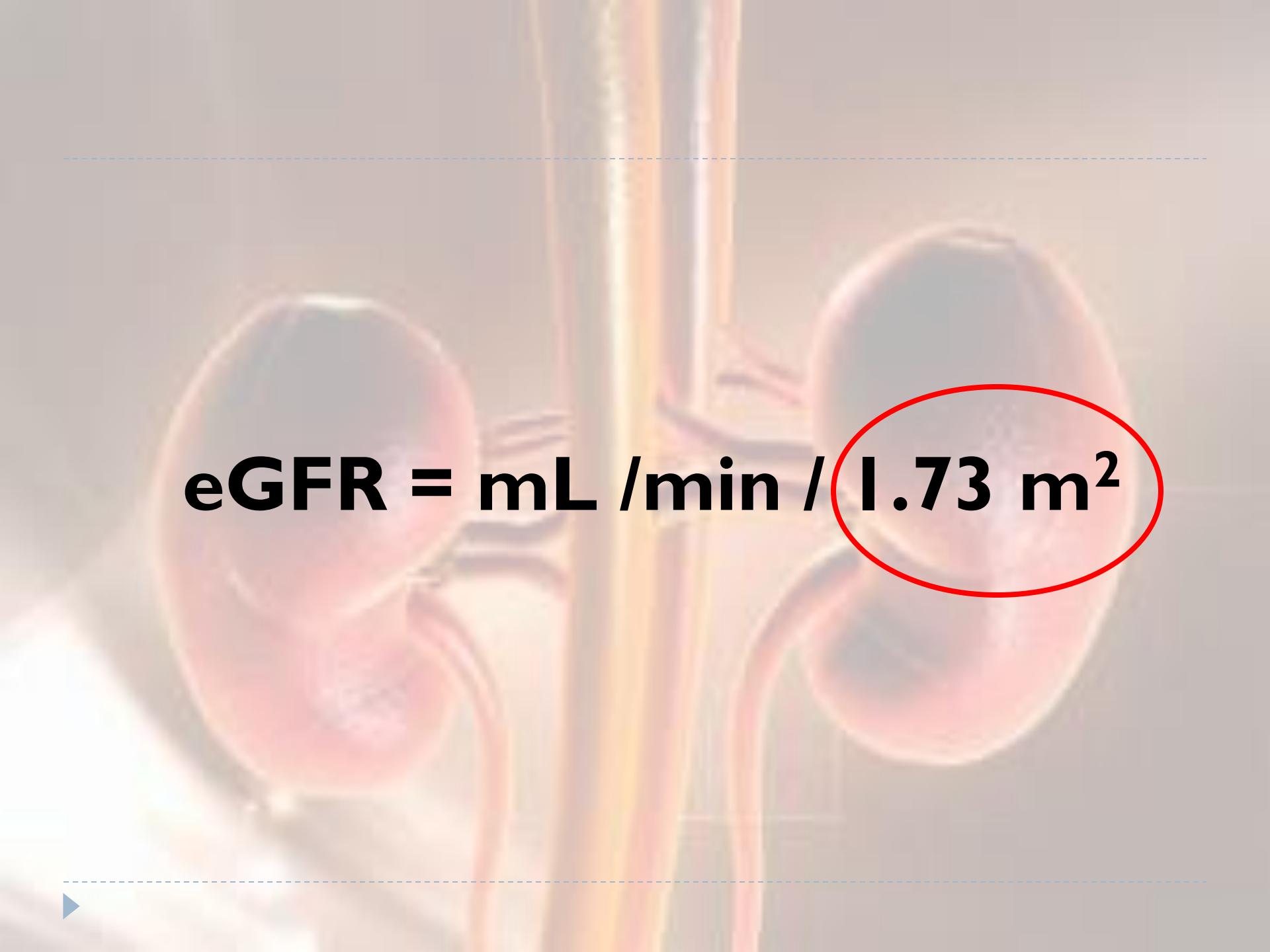
**Figure 1:** Relationship of estimated glomerular filtration rate (eGFR) as derived by the MDRD formula to age\*



\*A: median (50% of subjects have eGFR above this line); B: 80% of subjects have eGFR above this line; C: 97.5% of subjects have eGFR above this line. These reference lines are derived from over 300 000 presentations to a large private pathology service, with exclusion of creatinine results lying outside a Gaussian distribution for each age decade (personal communication, Ken Sikaris, Chemical Pathologist, Melbourne Pathology Service, VIC). ♦

Source: Matthew TH et al. Chronic kidney disease and automatic reporting of estimated glomerular filtration rate: revised recommendations. *MJA* 2007; 187: 459-46319.  
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**eGFR = mL /min / 1.73 m<sup>2</sup>**



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Zajčeva 19, 10000 Zagreb, Hrvatska. Tel/fax: +385 1 2353 847 <http://www.kb-merkur.hr>

7130

Predstojnica: Izv.prof.dr.sc. Zlata Flegar-Meštrić

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Uputio/la: OLM

Datum uzorkovanja: 12.2.2015

Liječnik/ca: X X

Datum prijema: 12.02.2015 07:20

Spol: Z Datum rođenja: 1981.

Primio/la: mag.med.biochem.Sandra Božičević,s

Barcode: 1202\*\*0039

**RADIŠIĆ-BILJAK VANJA****BIOKEMIJA**

Izradio/la: Božičević S.

Pretraga/Analit

**Rezultat****Jedinica**

Referentni interval

Napomena

(S) Standardizirani kreatinin*	75	µmol/L	49 - 90	IDMS sljedivost
(S) Ukupni bilirubin*	15	µmol/L	3 - 20	
(S) Aspartat-aminotransferaza*	16	U/L	11 - 34	
(S) Alanin-aminotransferaza*	13	U/L	8 - 41	
(S) C-reaktivni protein*	0.4	mg/L	< 5.0	

## GFR Calculators: Serum Creatinine and Cystatin C (2012) (With SI Units)

4 variable MDRD Study Equation, CKD-EPI Creatinine Equation (2009), CKD-EPI Cystatin C Equation (2012) and CKD-EPI Cr  
(with SI Units)  
using standardized serum creatinine, age, race, gender and serum cystatin C

*programmed by Stephen Z. Fadem, M.D., FACP, FASN  
and Brian Rosenthal*

Serum creatinine

mg/dL   $\mu\text{mol}/\text{L}$

75

Serum Cystatin C (mg/L)

[ ]

NOTE: CKD-EPI GFR is only valid with serum creatinine methods are traceable to IDMS

Age

34 years

Race

African American  All other races\*

Gender

Male  Female

TRACEABLE TO IDMS (What is this?)

No  Yes

EQUATION:

CKD-EPI CREATININE (2009)

VALUE:

(mL/min/1.73 m<sup>2</sup>)

90

Remove Body Surface Area Adjustment to Express GFR in ml/min

**Remove Body Surface Area Adjustment  
to Express GFR in ml/min**

**Height**

feet inches       centimeters

178

**Weight**

Enter and select

pounds       kilograms

BSA ( $m^2$ ) =  $(W^{0.425} \times H^{0.725}) \times 0.007184$

Unadjusted CKD-EPI eGFR (ml/min) = eGFR (ml/min/ $1.73\ m^2$ )  $\times$  BSA ( $m^2$ ) / 1.73

BSA = **1.92  $m^2$**

<b>UNADJUSTED GFR</b>	<b>GFR VALUE</b>
CKD-EPI CREATININE EQ (2009)	100 ml/min
CKD-EPI CYSTATIN C EQUATION (2012)	0 ml/min
CKD-EPI CR-CYSTATIN C EQ (2012)	0 ml/min
MDRD STUDY EQUATION	85 ml/min

# GFR Calculators: Serum Creatinine and Cystatin C (2012) (With SI Units)

4 variable MDRD Study Equation, CKD-EPI Creatinine Equation (2009), CKD-EPI Cystatin C Equation (2012) and CKD-EPI  
(with SI Units)  
using standardized serum creatinine, age, race, gender and serum cystatin C

*programmed by Stephen Z. Fadem, M.D., FACP, FASN  
and Brian Rosenthal*

Serum creatinine

mg/dL   $\mu\text{mol}/\text{L}$

75

Serum Cystatin C (mg/L)

NOTE: CKD-EPI GFR is only valid with serum creatinine methods are traceable to IDMS

Age

60  years

Race

African American  All other races\*

Gender

Male  Female

TRACEABLE TO IDMS (What is this?)

No  Yes

**EQUATION:**

CKD-EPI CREATININE (2009)

**VALUE:**  
( $\text{mL}/\text{min}/1.73 \text{ m}^2$ )

75

Remove Body Surface Area Adjustment to Express GFR in ml/min

### Remove Body Surface Area Adjustment to Express GFR in ml/min

#### Height

feet inches

centimeters

150

#### Weight

Enter and select

pounds

kilograms

$$\text{BSA (m}^2\text{)} = (\text{W}^{0.425} \times \text{H}^{0.725}) \times 0.007184$$

$$\text{Unadjusted CKD-EPI eGFR (ml/min)} = \text{eGFR (ml/min}/1.73\text{ m}^2\text{)} \times \text{BSA (m}^2\text{)} / 1.73$$

$$\text{BSA} = 1.37\text{ m}^2$$

#### UNADJUSTED GFR

CKD-EPI CREATININE EQ (2009)

CKD-EPI CYSTATIN C EQUATION (2012)

CKD-EPI CR-CYSTATIN C EQ (2012)

MDRD STUDY EQUATION

#### GFR VALUE

59 ml/min

0 ml/min

0 ml/min

54 ml/min



**TEORIJA**



**PRAKSA**



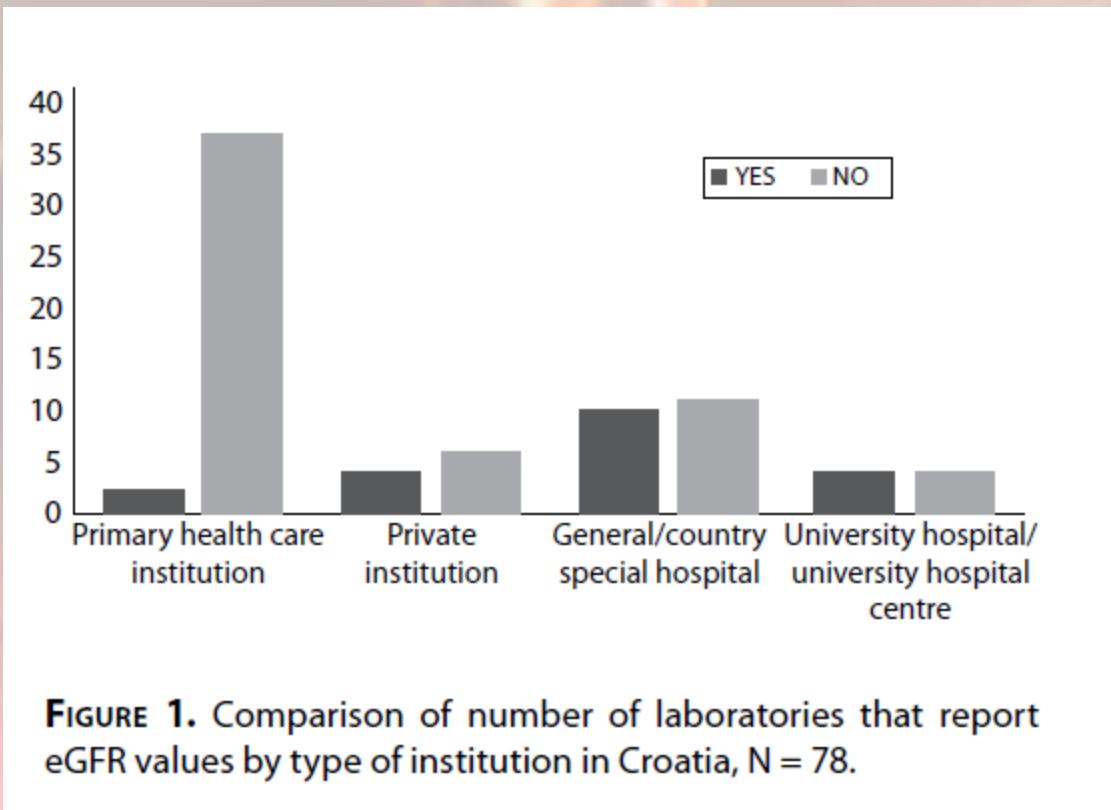
## Original papers

### Laboratory diagnostics of chronic kidney disease in Croatia: state of the art

Vanja Radišić Biljak<sup>\*1</sup>, Lorena Honović<sup>2</sup>, Jasmina Matica<sup>3</sup>, Branka Knežević<sup>4</sup>, Sanela Šimić Vojak<sup>5</sup>

On behalf of the joint working group of Croatian society of medical biochemistry and laboratory medicine and Croatian chamber for medical biochemists for laboratory diagnostics in chronic kidney disease







# BIOCHEMIA MEDICA

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Role: Author ▼ Username: Vanja\_Biljak

## Submissions Needing Revision for Author Vanja Radisic Biljak, PhD

Click 'File Inventory' to download the source files for the manuscript. Click 'Revise Submission' to submit a revision of the manuscript. If you Decline To Revise the manuscript, it will be moved to the Declined Revisions folder.

IMPORTANT: If your revised files are not ready to be submitted, do not click the 'Revise Submission' link.

Page: 1 of 1 (1 total submissions)

Display 10 ▼ results per page.

Action	Manuscript Number	Title	Initial Date Submitted	Date Revision Due	Status Date	Current Status	View Decision
<a href="#">Action Links</a>	BioChemMed-D-15-00023	CROATIAN NATIONAL RECOMMENDATIONS FOR LABORATORY DIAGNOSTICS AND CLASSIFICATION OF CHRONIC KIDNEY DISEASE On behalf of the joint working group of Croatian society of medical biochemistry and laboratory medicine and Croatian chamber for medical biochemists for laboratory diagnostics in chronic kidney disease	Mar 13, 2015	Jul 20, 2015	Jul 02, 2015	Revised	<a href="#">Revise</a>

Page: 1 of 1 (1 total submissions)

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