Estimation du débit de filtration glomérulaire

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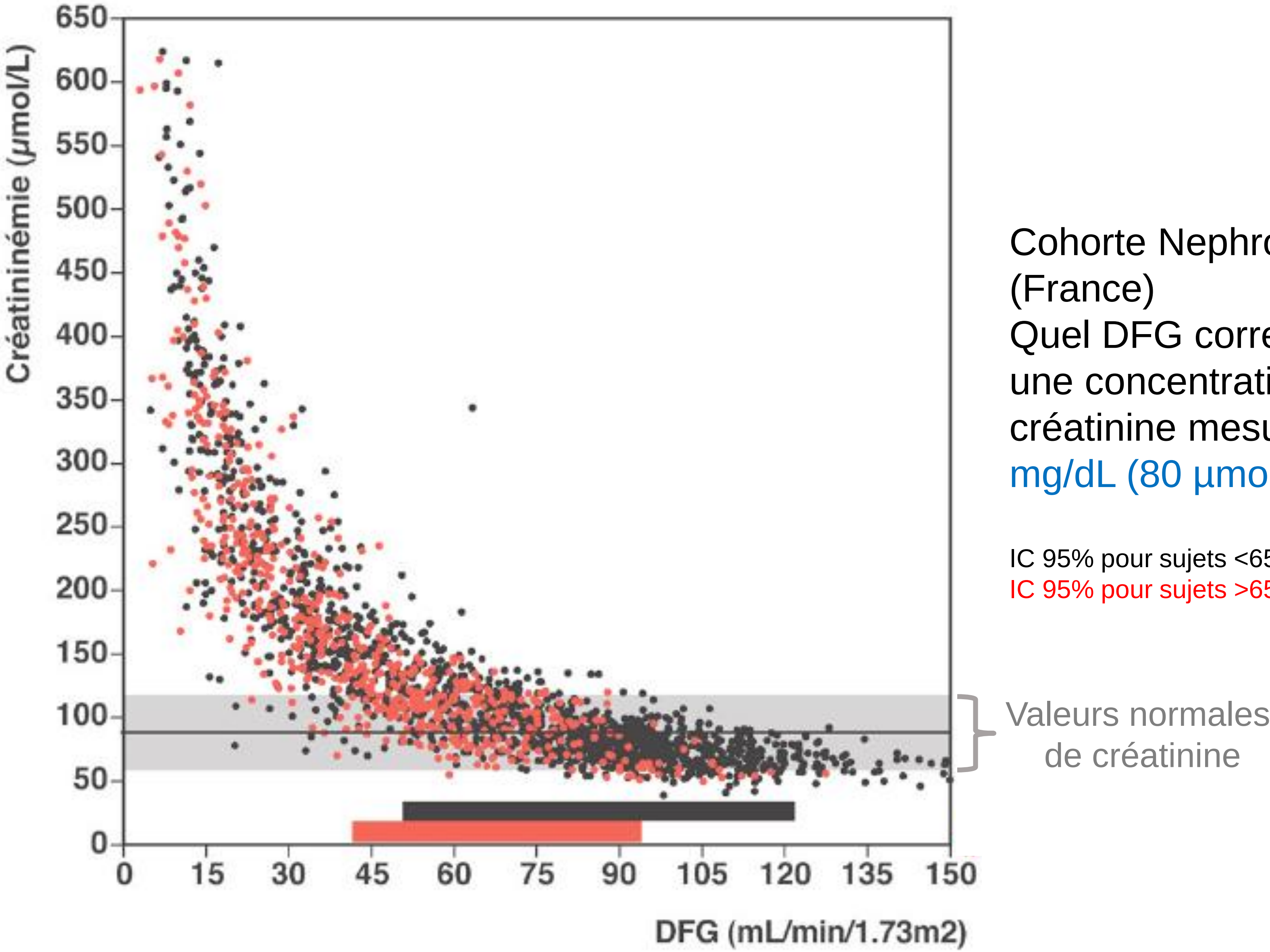
Lyon le 7 décembre 2021

Créatinine sérique

- Une des analyses les plus prescrites
- …mais important d'en connaitre les limitations
- Limitations physiologiques
- Limitations analytiques
- Limitations "mathématiques"

Perrone RD, Clin Chem, 1992, 38, 1933
Delanaye P, Ann Biol Clin (Paris), 2010, 68, 531



Cohorte NephroTest (France)
Quel DFG correspond à une concentration de créatinine mesurée à 0.9 mg/dL (80 µmol/L) ?

IC 95% pour sujets <65 ans
IC 95% pour sujets >65 ans

Avec la permission de Marc Froissart

Créatinine: « limitations mathématiques »

- Relation hyperbolique entre créatinine et DFG!!!

Pour un patient donné,

si la créatinine augmente de 0.6 à 1.2 mg/dl
=> diminution du DFG de 50%

si la créatinine augmente de 2.0 à 3.0 mg/dl
=> diminution du DFG de 25%

Mesure de la créatinine sérique
Limitations analytiques

- Méthodes de Jaffe
- Méthodes enzymatiques
- Différentes méthodes mais aussi différents « assays »
- Interférences

Perrone RD, Clin Chem, 1992, 38, 1933
Delanaye P, Ann Biol Clin (Paris), 2010, 68, 531

Beaucoup de progrès ces dernières années…

Clinica Chimica Acta 412 (2011) 2070–2075

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Clinica Chimica Acta

journal homepage: www.elsevier.com/locate/clinchim

A multicentric evaluation of IDMS-traceable creatinine enzymatic assays

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On behalf of the Société Française de Biologie Clinique [1]

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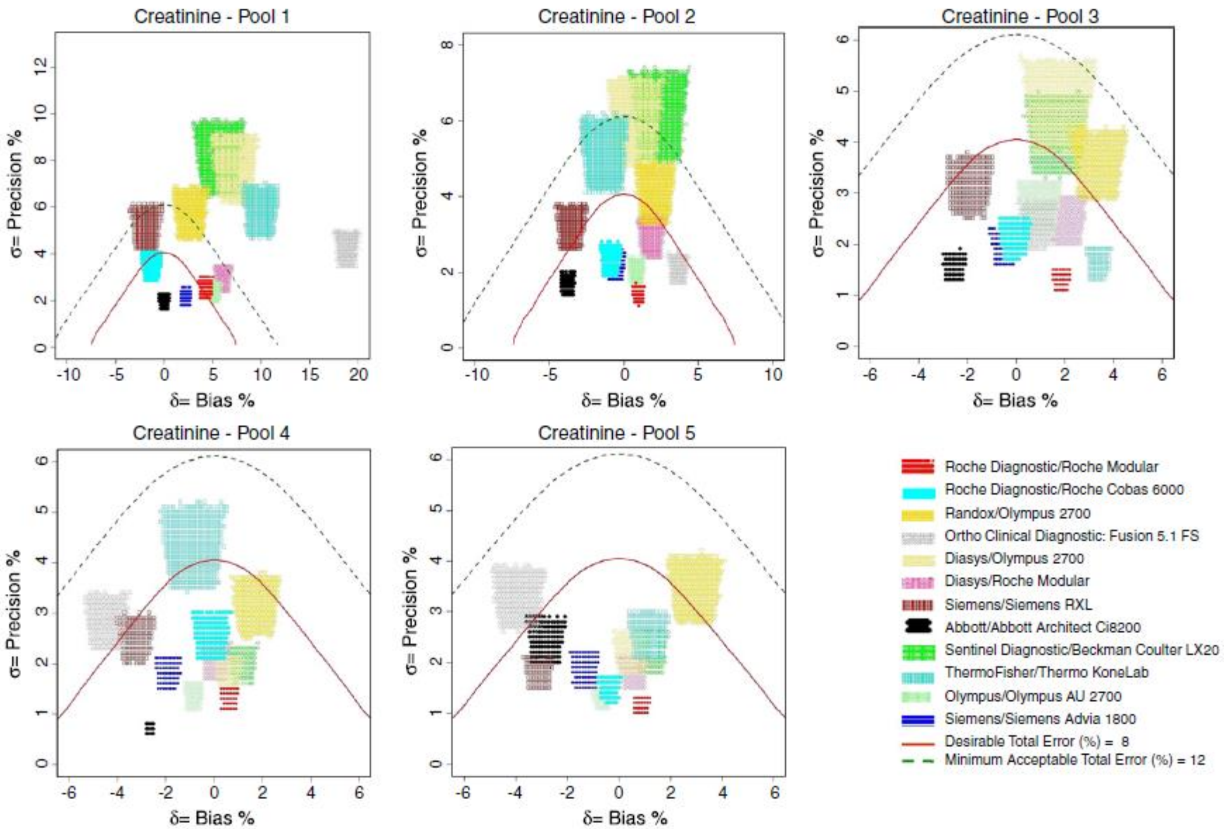
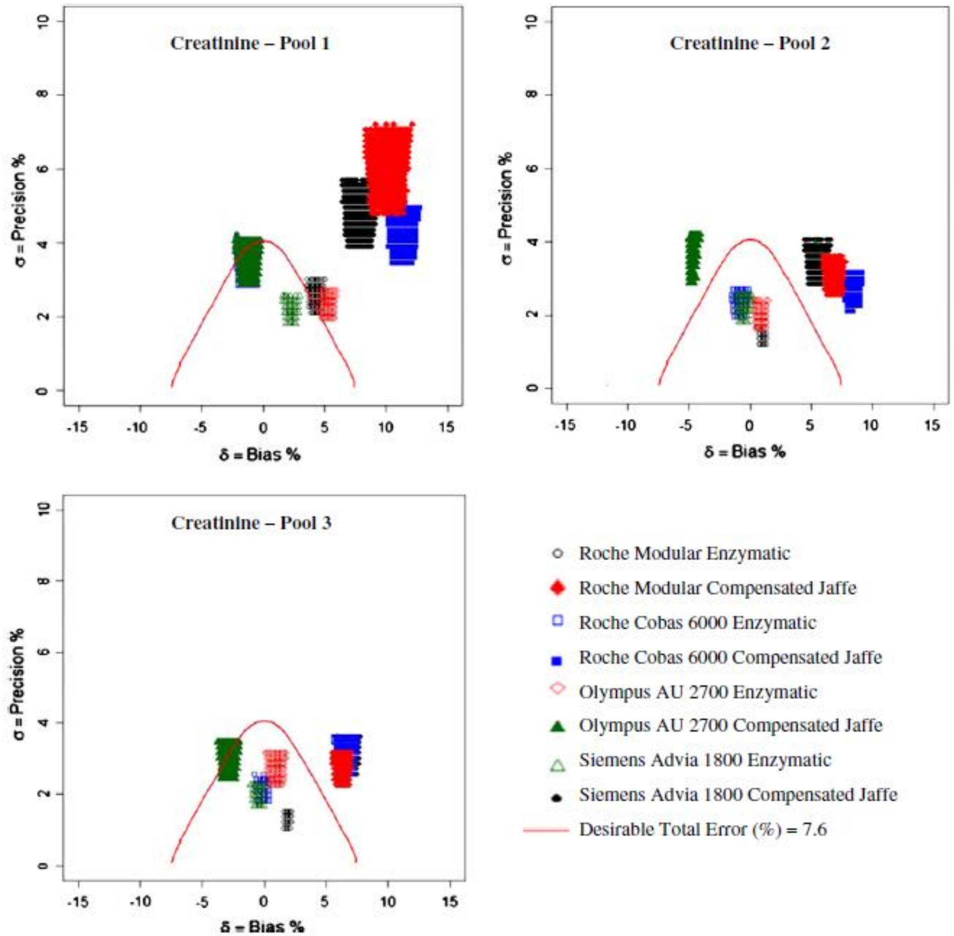
Results of GC-IDMS from LNE

Pool 5: 174.5 +/-3.1 µmol/L
Pool 4: 149.7 +/-2.9 µmol/L
Pool 3: 97.9 +/-1.7 µmol/L
Pool 2: 74.4 +/-1.4 µmol/L
Pool 1 : 35.9 +/-0.9 µmol/L





Boutten A, Clin Chim Acta, 2013, 419, p132

Limitations physiologiques

- Sécrétion tubulaire de créatinine

10 to 40%

Sécrétion augmente alors que DFG diminue

Non prédictible à l'échelon individuel

- Production extra-rénale

Perrone RD, Clin Chem, 1992, 38, 1933
Delanaye P, Ann Biol Clin (Paris), 2010, 68, 531

Limitations physiologiques

- Production (relativement) constante d'origine musculaire => la concentration de créatinine dépend de la masse musculaire, pas seulement du DFG
  - genre
  - âge
  - ethnicité
  - Masse musculaire

Perrone RD, Clin Chem, 1992, 38, 1933
Delanaye P, Ann Biol Clin (Paris), 2010, 68, 531

Créatinine: à la poubelle?

- Bon marché! (0.04€ / Jaffe)
- Bonne spécificité
- Bon CV analytique
- Préférence pour les méthodes enzymatiques

Clairance de créatinine

- N'est recommandée par aucun guidelines
- Sécrétion tubulaire
- Manque de précision:

erreurs dans la collecte

22 à 27% chez les patients « entrainés »

50 to 70 % pour les autres

importante variabilité intra-individuelle de l'excrétion urinaire de créatinine

KDIGO, Kidney Int, 2012, 3

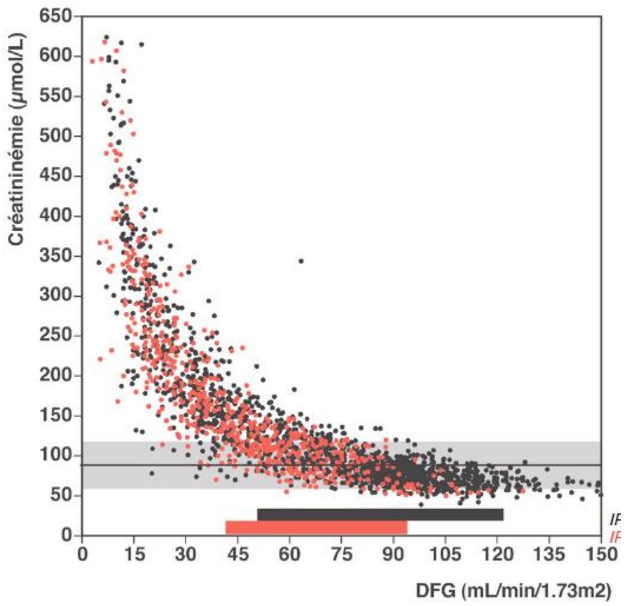
Perrone RD, Clin Chem, 1992, 38, 1933

Delanaye P, Ann Biol Clin (Paris), 2010, 68, 531

Equations basées sur la créatinine

But des équations:

- Conceptualiser la relation hyperbolique
- Adapter la créatinine pour l'âge, le genre, l'ethnicité
- Diminuer l'IC (?)



Quelles équations?

- Cockcroft
- MDRD
- CKD-EPI
- EKFC

Cockcroft Vs MDRD Vs CKD-EPI

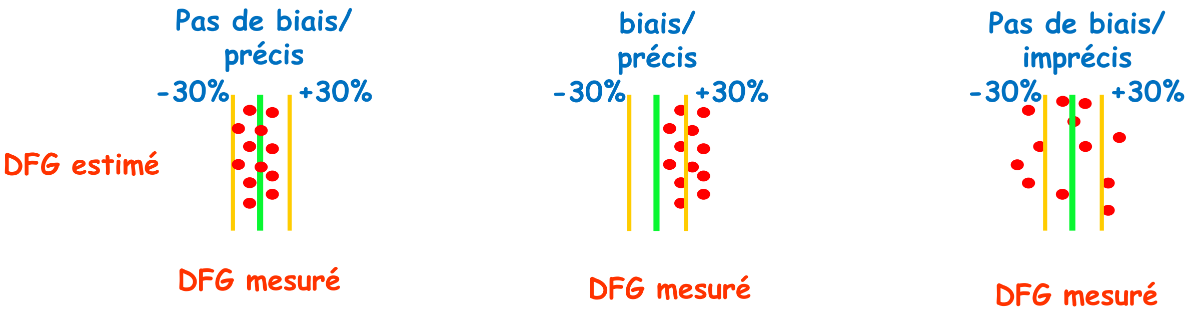
	Cockcroft	MDRD	CKD-EPI
Population	Canada 1976	USA 1999	« International » 2009
N	249	1628	5504+2750+3896
DFG moyen	73	40	68
DFG de référence	Clairance de créatinine	Iothalamate	Divers mais référence
Assay	« Jaffe »	Jaffe calibré	Jaffe calibré
% femmes	4	40	43-45%
% noir	0 (?)	12	10-32%
Age moyen	18-92	51	47-50
Poids moyen	72	79.6	79-82
Indexation pour BSA	Non	Oui	Oui
Validation interne	Non	Oui	Oui

Cockcroft DW, Nephron, 1976, 16, p31
Levey AS, Ann Intern Med, 1999, 130, p461
Levey AS, Ann Intern Med, 2009, p604

POIDS !!

Statistiques

- Corrélation: une condition “*sine qua non”* mais insuffisante!
- Biais: différence moyenne entre 2 valeurs = erreur systématique
- Précision: SD autour de ce biais = erreur aléatoire
- Exactitude 30% = % du DFG estimée dans ± 30% du DFG mesuré



Bland JM, Altman DG, Lancet, 1986, 8476, 307
Delanaye P, Nephrol Dial Transplant, 2013, 28, 1396

30%

Ann Intern Med. 2021;174:183-191. doi:10.7326/M20-4366

Annals of Internal Medicine

ORIGINAL RESEARCH

Development and Validation of a Modified Full Age Spectrum Creatinine-Based Equation to Estimate Glomerular Filtration Rate

A Cross-sectional Analysis of Pooled Data

Hans Pottel, PhD*; Jonas Björk, PhD*; Marie Courbebaisse, MD, PhD; Lionel Couzi, MD, PhD; Natalie Ebert, MD, MPH; Björn O. Eriksen, MD, PhD; R. Neil Dalton, PhD; Laurence Dubourg, MD, PhD; François Gaillard, MD, PhD; Cyril Garrouste, MD; Anders Grubb, MD, PhD; Lola Jacquemont, MD, PhD; Magnus Hansson, MD, PhD; Nassim Kamar, MD, PhD; Edmund J. Lamb, PhD; Christophe Legendre, MD; Karin Littmann, MD; Christophe Mariat, MD, PhD; Toralf Melsom, MD, PhD; Lionel Rostaing, MD, PhD; Andrew D. Rule, MD; Elke Schaeffner, MD, PhD, MSc; Per-Ola Sundin, MD, PhD; Stephen Turner, MD, PhD; Arend Bökenkamp, MD; Ulla Berg, MD, PhD; Kajsa Åsling-Monemi, MD, PhD; Luciano Selistre, MD, PhD; Anna Åkesson, BSc; Anders Larsson, MD, PhD; Ulf Nyman, MD, PhD†; and Pierre Delanaye, MD, PhD†

- Sujets avec DFG mesuré et créatinine standardisée
- n=11,251 “development and internal validation”
- n=8,378 “external validation”
- n=1,254 ages entre 2 et 18 ans
- 7 + 6 cohorts
- « Caucasiens »

Figure 1. The new EKFC equation.

Age	SCr/Q	Equation
2–40 y	<1	$107.3 \times (SCr/Q)^{-0.322}$
	≥1	$107.3 \times (SCr/Q)^{-1.132}$
>40 y	<1	$107.3 \times (SCr/Q)^{-0.322} \times 0.990^{(Age - 40)}$
	≥1	$107.3 \times (SCr/Q)^{-1.132} \times 0.990^{(Age - 40)}$

Q Values

For ages 2–25 y:

Males:

$$\ln(Q) = 3.200 + 0.259 \times Age - 0.543 \times \ln(Age) - 0.00763 \times Age^2 + 0.0000790 \times Age^3$$

Females:

$$\ln(Q) = 3.080 + 0.177 \times Age - 0.223 \times \ln(Age) - 0.00596 \times Age^2 + 0.0000686 \times Age^3$$

For ages >25 y:

Males:

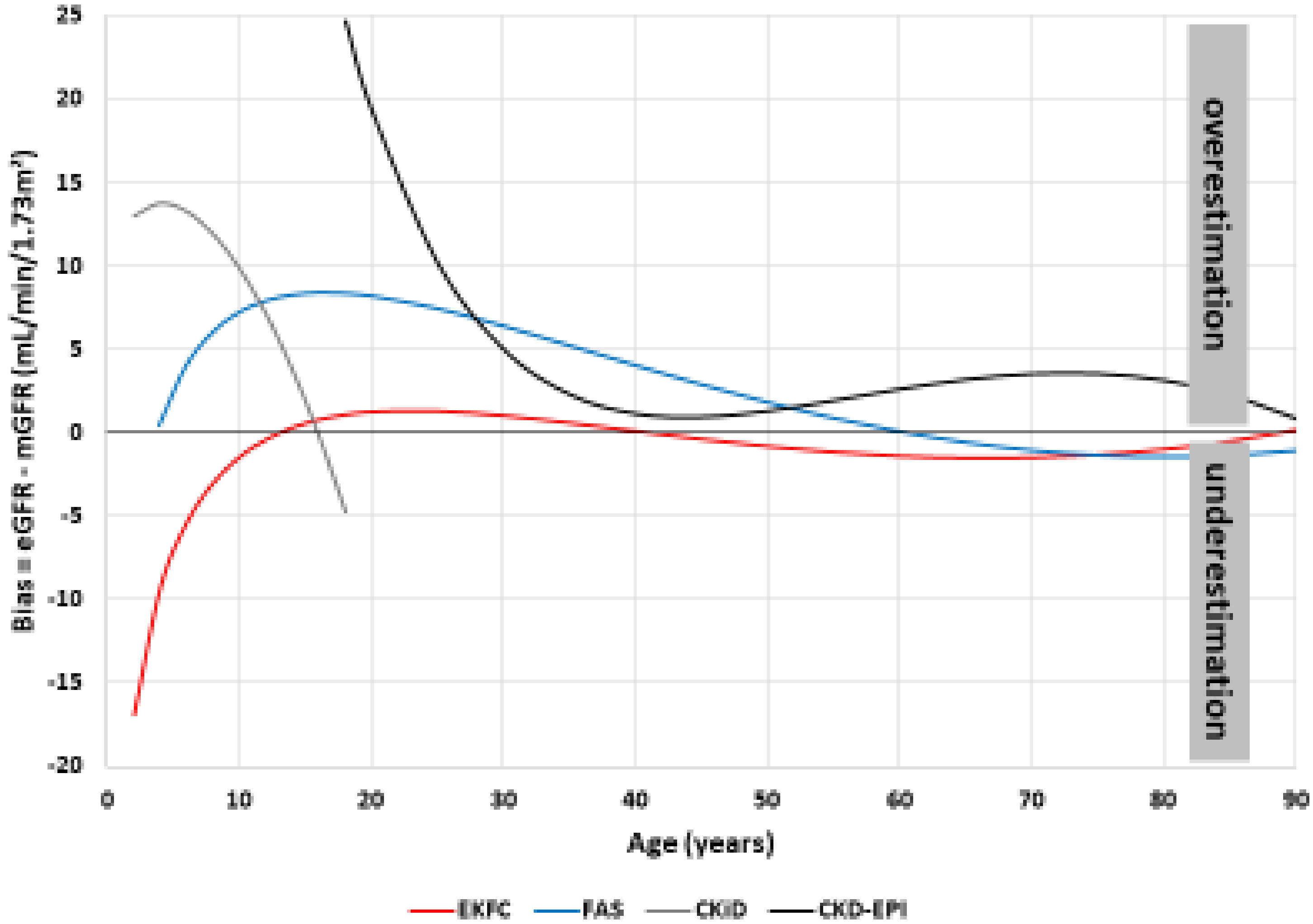
Q = 80 μmol/L (0.90 mg/dL)

Females:

Q = 62 μmol/L (0.70 mg/dL)

SCr and Q in μmol/L (to convert to mg/dL, divide by 88.4)

Q values (in μmol/L or mg/dL) correspond to the median SCr values for the age- and sex-specific populations. EKFC = European Kidney Function Consortium; SCr = serum creatinine.



25
20
15
10
5
0
-5
-10
-15
-20
Bias = eGFR - mGFR (mL/min/1.73m²)
0
10
20
30
40
50
60
70
80
90
Age (years)
overestimation
underestimation
EKFC
FAS
CKiD
CKD-EPI

	EKFC	FAS	CKD-EPI
Adults aged 18 to <40 y			
Median bias (95% CI), *mL/min/1.73 m²*			
All (*n* = 972)	0.8 (0.0 to 2.2)	7.3 (5.9 to 8.6)	7.8 (6.3 to 9.2)
eGFR <75 mL/min/1.73 m² (*n* = 137)	2.3 (0.3 to 4.2)	7.5 (4.7 to 8.8)	3.4 (1.7 to 5.8)
eGFR ≥75 mL/min/1.73 m² (*n* = 835)	0.6 (-0.5 to 1.9)	7.2 (5.8 to 8.8)	8.7 (7.2 to 10.6)
Imprecision, SD (P25-P75)			
All (*n* = 972)	17.2 (-8.3 to 10.3)	41.7 (-3.7 to 18.2)	20.5 (-2.0 to 18.2)
eGFR <75 mL/min/1.73 m² (*n* = 137)	14.2 (-3.2 to 9.2)	14.3 (1.4 to 13.4)	14.4 (-2.1 to 12.8)
eGFR ≥75 mL/min/1.73 m² (*n* = 835)	17.6 (-8.9 to 10.8)	44.6 (-4.3 to 19.3)	21.2 (-2.0 to 19.4)
Accuracy P30 (95% CI), %			
All (*n* = 972)	89.6 (87.7 to 91.5)	82.1 (79.7 to 84.5)	84.0 (81.6 to 86.3)
eGFR <75 mL/min/1.73 m² (*n* = 137)	80.3 (73.5 to 87.0)	71.5 (63.9 to 79.2)	78.8 (71.9 to 85.8)
eGFR ≥75 mL/min/1.73 m² (*n* = 835)	91.1 (89.2 to 93.1)	83.8 (81.3 to 86.3)	84.8 (82.3 to 87.2)
Adults aged 40 to <65 y			
Median bias (95% CI), *mL/min/1.73 m²*			
All (*n* = 3585)	-1.1 (-1.6 to -0.6)	1.1 (0.5 to 1.6)	1.8 (1.3 to 2.4)
eGFR <60 mL/min/1.73 m² (*n* = 492)	1.9 (1.3 to 2.8)	4.7 (4.1 to 5.3)	1.5 (0.7 to 2.5)
eGFR ≥60 mL/min/1.73 m² (*n* = 3093)	-2.0 (-2.5 to -1.5)	-0.2 (-0.8 to 0.6)	1.9 (1.3 to 2.5)
Imprecision, SD (P25-P75)			
All (*n* = 3585)	15.1 (-9.4 to 7.4)	17.8 (-8.3 to 10.5)	15.4 (-6.1 to 10.9)
eGFR <60 mL/min/1.73 m² (*n* = 492)	9.2 (-2.5 to 7.3)	9.4 (-0.5 to 10.0)	9.2 (-2.8 to 6.9)
eGFR ≥60 mL/min/1.73 m² (*n* = 3093)	15.8 (-10.5 to 7.5)	18.7 (-9.4 to 10.6)	16.1 (-6.8 to 11.6)
Accuracy P30 (95% CI), %			
All (*n* = 3585)	89.5 (88.5 to 90.5)	85.9 (84.8 to 87.1)	88.2 (87.1 to 89.3)
eGFR <60 mL/min/1.73 m² (*n* = 492)	[illegible]	[illegible]	[illegible]
eGFR ≥60 mL/min/1.73 m² (*n* = 3093)	91.6 (90.6 to 92.5)	88.8 (87.7 to 89.9)	89.9 (88.9 to 91.0)
Adults aged ≥65 y			
Median bias (95% CI), *mL/min/1.73 m²*			
All (*n* = 2567)	-1.2 (-1.0 to -1.6)	-1.1 (-1.5 to -0.6)	3.0 (2.5 to 3.6)
eGFR <45 mL/min/1.73 m² (*n* = 852)	-0.5 (-0.9 to -0.1)	0.7 (0.2 to 1.2)	0.5 (0.1 to 0.9)
eGFR ≥45 mL/min/1.73 m² (*n* = 1715)	-2.0 (-2.6 to -1.3)	-2.9 (-3.7 to -2.4)	5.1 (4.3 to 6.0)
Imprecision, SD (P25-P75)			
All (*n* = 2567)	12.1 (-7.6 to 5.0)	14.3 (-8.5 to 5.3)	12.5 (-2.9 to 10.2)
eGFR <45 mL/min/1.73 m² (*n* = 852)	7.1 (-4.3 to 3.8)	7.2 (-3.5 to 5.1)	7.2 (-2.9 to 5.1)
eGFR ≥45 mL/min/1.73 m² (*n* = 1715)	13.9 (-9.6 to 6.1)	16.7 (-10.8 to 5.8)	14.3 (-2.9 to 13.1)
Accuracy P30 (95% CI), %			
All (*n* = 2567)	85.3 (83.9 to 86.7)	83.6 (82.1 to 85.0)	80.7 (79.2 to 82.2)
eGFR <45 mL/min/1.73 m² (*n* = 852)	[illegible]	[illegible]	[illegible]
eGFR ≥45 mL/min/1.73 m² (*n* = 1715)	89.6 (88.1 to 91.0)	88.4 (86.9 to 89.9)	83.7 (81.9 to 85.4)

Un expert, c'est une opinion. Deux experts, c'est la contradiction. Trois experts, c'est la confusion.

Anonyme [redacted]

Limitations des formules = créatinine

Populations spécifiques:
Les équations ne sont pas magiques!!
Gardons notre sens clinique!!

Anorexie nerveuse (Delanaye P, Clin Nephrol, 2009, 71, 482)

Cirrhose (Skluzacek PA, Am J Kidney Dis, 2003, 42, 1169)

USI (Delanaye P, BMC Nephrology, 2014, 15, 9)

Hospitalisés (Poggio ED, Am J Kidney Dis, 2005, 46, 242)

Greffés cœur (Delanaye P, Clin Transplant, 2006, 20, 596)

Greffés rein (Masson I, Transplantation, 2013, 95, 1211)

Obèse (Bouquegneau A, NDT, 2013, 28, iv122)

Nephrol Dial Transplant (2019) 34: 287–294
doi: 10.1093/ndt/gfy086
Advance Access publication 11 May 2018

Chronic kidney disease staging with cystatin C or creatinine-based formulas: flipping the coin

Sergio Luis-Lima[1], Beatriz Escamilla-Cabrera[2], Natalia Negrín-Mena[1], Sara Estupiñán[2], Patricia Delgado-Mallén[2], Domingo Marrero-Miranda[2], Ana González-Rinne[2], Rosa Miquel-Rodríguez[2], María Ángeles Cobo-Caso[2], Manuel Hernández-Guerra[3], Juana Oramas[4], Norberto Batista[4], Ana Aldea-Perona[1], Pablo Jorge-Pérez[5], Carlos González-Alayón[3], Miguel Moreno-Sanfiel[3], Juan Antonio González-Rodríguez[6], Laura Henríquez[7], Raquel Alonso-Pescoso[7], Laura Díaz-Martín[1], Federico González-Rinne[1], Bernardo Alio Lavín-Gómez[8], Judith Galindo-Hernández[7], Macarena Sánchez-Gallego[7], Alejandra González-Delgado[9], Alejandro Jiménez-Sosa[1], Armando Torres[2,10] and Esteban Porrini[10]

- N=882
- Clairance plasmatique d'iohexol
- 4-174 mL/min/1.73m²

GFR categories	eGFR (ml/min/1.73 m^2)
G1	≥90
G2	60-89
G3a	45-59
G3b	30-44
G4	15-29
G5	<15

KIDNEY DISEASE · IMPROVING GLOBAL OUTCOMES
KDIGO ®

Table 2. Classification of patients in CKD stages by a representative group of nine creatinine and/or cystatin C–based formulas

Creatinine

Stage	Cockcroft–Gault GFR	N	True positive	False positive	Missing
1	178	242	142 (80%)	100 (41%)[a]	36 (20%)
2	252	254	136 (54%)	118 (46%)	116 (46%)
3	251	248	151 (60%)	97 (39%)	100 (40%)
4	176	124	99 (56%)	25 (20%)	77 (44%)
5	25	14	6 (24%)	8 (57%)	19 (76%)

Stage	aMDRD GFR	N	True positive	False positive	Missing
1	178	175	115 (65%)	60 (34%)	63 (35%)
2	252	259	145 (58%)	114 (44%)	107 (42%)
3	251	257	166 (66%)	91 (35%)	85 (34%)
4	176	157	121 (69%)	36 (23%)	55 (31%)
5	25	34	13 (52%)	21 (62%)	12 (48%)

Stage	CKD–EPI GFR	N	True positive	False positive	Missing
1	178	222	136 (76%)	86 (39%)	42 (24%)
2	252	241	138 (55%)	103 (43%)	114 (45%)
3	251	226	155 (62%)	71 (31%)	96 (38%)
4	176	156	121 (69%)	35 (22%)	55 (31%)
5	25	37	13 (52%)	24 (65%)	12 (48%)

Cystatin-C

Stage	Le Bricon GFR	N	True positive	False positive	Missing
1	178	259	162 (91%)	97 (37%)	16 (9%)
2	252	243	148 (59%)	95 (39%)	104 (41%)
3	251	329	170 (68%)	159 (48%)	81 (32%)
4	176	50	32 [illegible]	[illegible]	[illegible]
5	25	1	1 [illegible]	[illegible]	[illegible]

Stage	MCQ GFR	N	True positive	False positive	Missing
1	178	146	114 (64%)	32 (22%)	64 (36%)
2	252	205	127 (50%)	78 (38%)	125 (50%)
3	251	274	166 (66%)	108 (39%)	85 (34%)
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Stage	CKD–EPI GFR	N	True positive	False positive	Missing
1	178	229	155 (87%)	74 (32%)	23 (13%)
2	252	182	128 (51%)	54 (30%)	124 (49%)
3	251	246	177 (71%)	69 (28%)	74 (29%)
4	[illegible]	[illegible]	[illegible]	[illegible] 2 (27%)	36 (20%)
5	[illegible]	[illegible]	[illegible]	[illegible] 9 (58%)	11 (44%)

Creatinine + Cystatin-C

Stage	GFR	N	True positive	False positive	Missing
1	178	288	168 [illegible]	[illegible]	[illegible]
2	252	207	127 [illegible]	[illegible]	[illegible]
3	251	227	172 [illegible]	[illegible]	[illegible]
4	176	149	130 [illegible]	[illegible]	[illegible]
5	25	11	8 [illegible]	[illegible]	[illegible]

Stage	[illegible] GFR	N	True positive	False positive	Missing
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Stage	[illegible]I GFR	N	True positive	False positive	Missing
1	[illegible]	[illegible]	[illegible]	[illegible]5 (29%)	20 (11%)
2	[illegible]	[illegible]	[illegible]	[illegible]0 (28%)	98 (39%)
3	[illegible]	[illegible]	[illegible]	[illegible]3 (23%)	78 (31%)
4	[illegible]	[illegible]	[illegible]	[illegible]2 (24%)	40 (23%)
5	[illegible]	[illegible]	[illegible]	[illegible]2 (54%)	6 (24%)

Results. Misclassification was a constant for all 61 formulas evaluated and averaged 50% for creatinine-based and 35% for cystatin C–based equations. Most of the cases were misclassified as one stage higher or lower. However, in 10% of the subjects, one stage was skipped and patients were classified two stages above or below their real stage. No clinically relevant improvement was observed with cystatin C–based formulas compared with those based on creatinine.

'True positives cases' represent the subjects that were corretly classified in each CKD stage by eGFR. 'False positives cases' represent the patients who were classified in one CKD stage based on eGFR when actually belonging to a different stage. 'Missing cases' represent the cases that were not classified in the corresponding CKD stage.

[a]The percentage of false positive cases refers to the number of cases defined in each CKD stage by mGFR (grey column). The percentage of true positive and missing cases refers to the number of cases defined in each CKD stage by eGFR.

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ORIGINAL ARTICLE

Performance of creatinine-based equations to estimate glomerular filtration rate with a methodology adapted to the context of drug dosage adjustment

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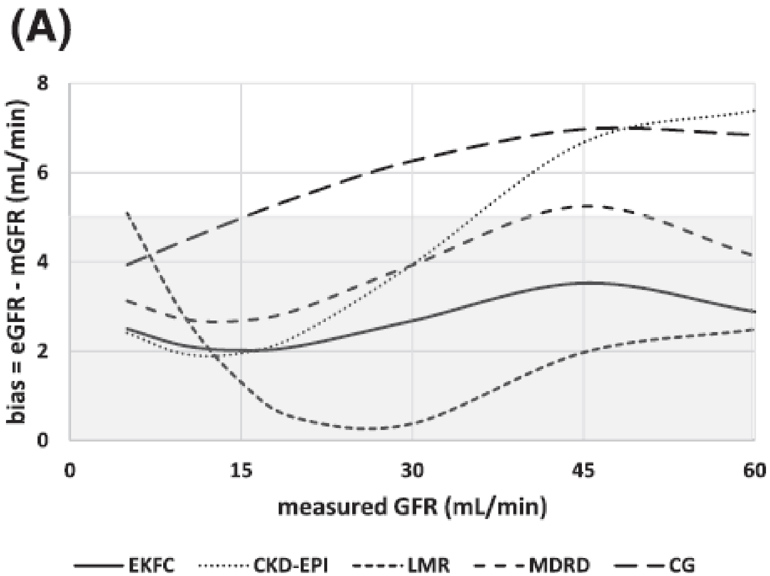
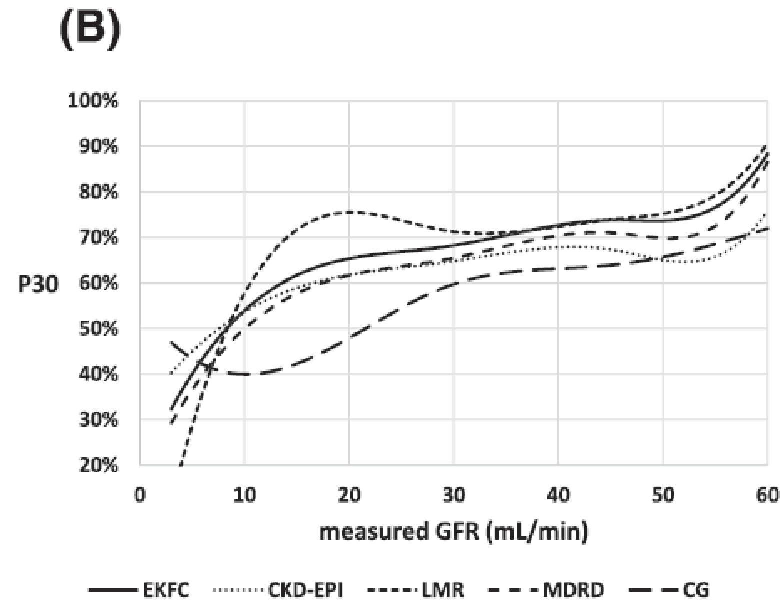
Br J Clin Pharmacol. 2021;1–10.

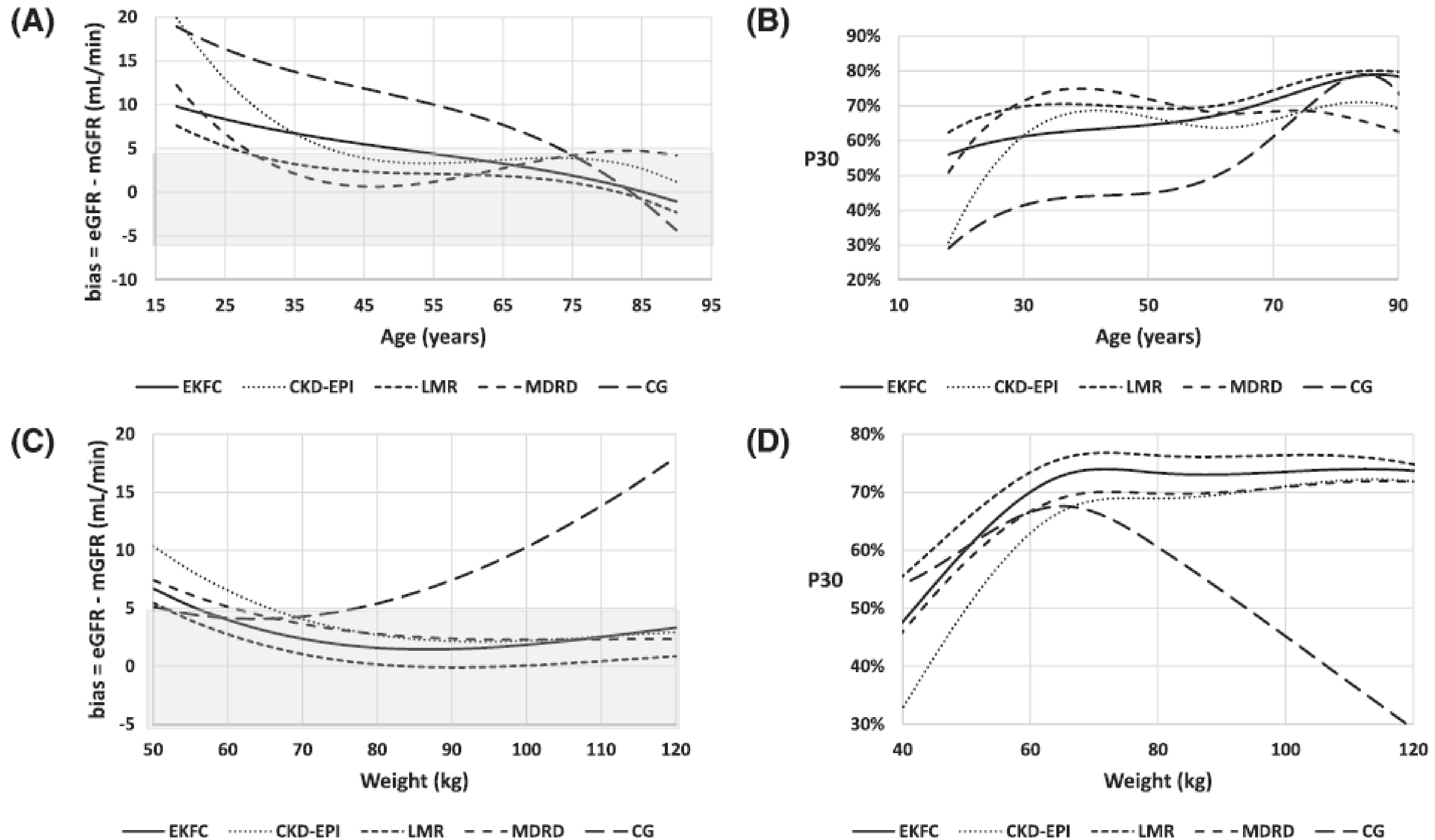
- 14,804 participants
- MDRD, CKD-EPI, LMR, et EKFC
- De-indexé
- Focus sur DFG< 60 mL/min (n=4328)



(A)
bias = eGFR - mGFR (mL/min)
8
6
4
2
0
0
15
30
45
60
measured GFR (mL/min)
EKFC
CKD-EPI
LMR
MDRD
CG



(B)
P30
100%
90%
80%
70%
60%
50%
40%
30%
20%
0
10
20
30
40
50
60
measured GFR (mL/min)
EKFC
CKD-EPI
LMR
MDRD
CG


(A)
bias = eGFR - mGFR (mL/min)
20
15
10
5
0
-5
-10
15 25 35 45 55 65 75 85 95
Age (years)
EKFC CKD-EPI LMR MDRD CG
(B)
P30
90%
80%
70%
60%
50%
40%
30%
20%
10 30 50 70 90
Age (years)
EKFC CKD-EPI LMR MDRD CG
(C)
bias = eGFR - mGFR (mL/min)
20
15
10
5
0
-5
50 60 70 80 90 100 110 120
Weight (kg)
EKFC CKD-EPI LMR MDRD CG
(D)
P30
80%
70%
60%
50%
40%
30%
40 60 80 100 120
Weight (kg)
EKFC CKD-EPI LMR MDRD CG

Staging

- Erreur de 1 classe:

Cockcroft: 46.1%

MDRD: 43.1%

CKDEPI: 43.7%

EKFC: 41.1%

- Erreur de 2 classes:

Cockcroft: 9,3%

MDRD: 6,2%

CKDEPI: 7,2%

EKFC: 5,4%

Le facteur “racial” dans les formules basées sur la créatinine

- « race »
- Très débattu aux USA…

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

New Creatinine- and Cystatin C–Based Equations to Estimate GFR without Race

L.A. Inker, N.D. Eneanya, J. Coresh, H. Tighiouart, D. Wang, Y. Sang, D.C. Crews, A. Doria, M.M. Estrella, M. Froissart, M.E. Grams, T. Greene, A. Grubb, V. Gudnason, O.M. Gutiérrez, R. Kalil, A.B. Karger, M. Mauer, G. Navis, R.G. Nelson, E.D. Poggio, R. Rodby, P. Rossing, A.D. Rule, E. Selvin, J.C. Seegmiller, M.G. Shlipak, V.E. Torres, W. Yang, S.H. Ballew, S.J. Couture, N.R. Powe, and A.S. Levey, for the Chronic Kidney Disease Epidemiology Collaboration*

› N Engl J Med. 2021 Nov 4;385(19):1737-1749.

Table 3. Accuracy of Current and New Approaches for GFR Estimation as Compared with Measured GFR in the Validation Data Set.

Filtration Marker and Equation*	Black Participants	Non-Black Participants	Difference between Black Participants and Non-Black Participants (95% CI)†
	Bias: Median Difference between Measured GFR and eGFR (95% CI)‡		
		milliliters per minute per 1.73 square meters	
Creatinine			
eGFRcr(ASR), current	−3.7 (−5.4 to −1.8)	−0.5 (−0.9 to 0.0)	−3.2 (−5.0 to −1.3)
eGFRcr(ASR-NB), new	7.1 (5.9 to 8.8)	−0.5 (−0.9 to 0.0)	7.6 (6.1 to 9.0)
eGFRcr(AS), new	3.6 (1.8 to 5.5)	−3.9 (−4.4 to −3.4)	7.6 (5.6 to 9.5)
Creatinine			
eGFRcr(ASR), current	85.1 (82.2 to 87.9)	89.5 (88.5 to 90.4)	−4.4 (−7.6 to −1.2)
eGFRcr(ASR-NB), new	86.4 (83.4 to 89.1)	89.5 (88.5 to 90.4)	−3.1 (−6.2 to 0)
eGFRcr(AS), new	87.2 (84.5 to 90.0)	86.5 (85.4 to 87.6)	0.7 (−2.4 to 3.8)

Ethnic, race factors in Africa and Europe

Flamant M et al

RESEARCH LETTER

Performance of GFR Estimating Equations in African Europeans: Basis for a Lower Race-Ethnicity Factor Than in African Americans

Am J Kidney Dis, 2013, 62, p179

NON

PLOS | ONE

RESEARCH ARTICLE

Performance of glomerular filtration rate estimation equations in Congolese healthy adults: The inopportunity of the ethnic correction

Justine B. Bukabau[1]*, Ernest K. Sumaili[1], Etienne Cavalier[2], Hans Pottel[3], Bejos Kifakiou[1], Aliocha Nkodila[1], Jean Robert R. Makulo[1], Vieux M. Mokoli[1], Chantal V. Zinga[1], Augustin L. Longo[1], Yannick M. Engole[1], Yannick M. Nlandu[1], François B. Lepira[1], Nazaire M. Nseka[1], Jean Marie Krzesinski[4], Pierre Delanaye[4]

1 Renal Unit, Department of Internal medicine, Kinshasa University Hospital, University of Kinshasa, Kinshasa, Democratic Republic of the Congo, 2 Division of Clinical Chemistry, CHU Sart Tilman (ULg CHU), University of Liège, Liège, Belgium, 3 Division of Public Health and Primary Care, KU Leuven Campus Kulak Kortrijk, Kortrijk, Belgium, 4 Division of Nephrology-Dialysis-Transplantation, CHU Sart Tilman (ULg CHU), University of Liège, Liège, Belgium

* justinebuk@yahoo.fr

Check for updates

ARTICLE IN PRESS

www.kidney-international.org clinical investigation

Performance of creatinine- or cystatin C–based equations to estimate glomerular filtration rate in sub-Saharan African populations

Justine B. Bukabau[1,7], Eric Yayo[2,7], Appolinaire Gnionsahé[3], Dagui Monnet[2], Hans Pottel[4], Etienne Cavalier[5], Aliocha Nkodila[1], Jean Robert R. Makulo[1], Vieux M. Mokoli[1], François B. Lepira[1], Nazaire M. Nseka[1], Jean-Marie Krzesinski[6], Ernest K. Sumaili[1,7] and Pierre Delanaye[6,7]

[1]Renal Unit, Department of Internal Medicine, Kinshasa University Hospital, University of Kinshasa, Kinshasa, Democratic Republic of Congo; [2]Département de Biochimie, UFR Sciences Pharmaceutiques et Biologiques, Université Felix Houphouet Boigny, Abidjan, Ivory Coast; [3]Département de Néphrologie, UFR Sciences Médicales, Université Felix Houphouet Boigny, Abidjan, Ivory Coast; [4]Department of Public Health and Primary Care, KU Leuven Campus Kulak Kortrijk, Kortrijk, Belgium; [5]Division of Clinical Chemistry, CHU Sart Tilman (ULg CHU), University of Liège, Liège, Belgium; and [6]Division of Nephrology-Dialysis-Transplantation, CHU Sart Tilman (ULg CHU), University of Liège, Liège, Belgium

Néphrologie & Thérapeutique 12 (2016) 454–459

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Article original

Inadéquation du facteur ethnique pour l'estimation du débit de filtration glomérulaire en population générale noire-africaine : résultats en Côte d'Ivoire

Inadequacy of the African-American ethnic factor to estimate glomerular filtration rate in an African general population: Results from Côte d'Ivoire

Éric Sagou Yayo[a], Mireille Aye[a], Jean-Louis Konan[a], Arlette Emième[b], Marie-Laure Attoungbre[a], Appolinaire Gnionsahé[c], Étienne Cavalier[d], Dagui Monnet[a], Pierre Delanaye[e,*]

Yayo ES, Nephrol Ther, 2016, 12, 454
Flamant M, Am J Kdiney Dis, 2013, 62, 179
Bukabau JB, Plos One, 2018, 13, e0193384
Bukabau JB, Kidney Int, 2019, p1181

Cystatine C

Table 3. Accuracy of Current and New Approaches for GFR Estimation as Compared with Measured GFR in the Validation Data Set.

Filtration Marker and Equation*	Black Participants	Non-Black Participants	Difference between Black Participants and Non-Black Participants (95% CI)†
	Bias: Median Difference between Measured GFR and eGFR (95% CI)‡		
	milliliters per minute per 1.73 square meters		
	Agreement within 30% of Measured GFR (P_{30})§		
	percent		*percentage points*
Creatinine			
eGFRcr(ASR), current	85.1 (82.2 to 87.9)	89.5 (88.5 to 90.4)	−4.4 (−7.6 to −1.2)
eGFRcr(ASR-NB), new	86.4 (83.4 to 89.1)	89.5 (88.5 to 90.4)	−3.1 (−6.2 to 0)
eGFRcr(AS), new	87.2 (84.5 to 90.0)	86.5 (85.4 to 87.6)	0.7 (−2.4 to 3.8)
Cystatin C			
eGFRcys(AS), current	84.6 (81.7 to 87.6)	88.9 (87.9 to 89.9)	−4.3 (−7.5 to −1.1)
Creatinine–cystatin C			
eGFRcr-cys(ASR), current	88.6 (85.8 to 91.2)	92.4 (91.5 to 93.2)	−3.8 (−6.7 to −0.9)
eGFRcr-cys(ASR-NB), new	90.8 (88.4 to 93.1)	92.4 (91.5 to 93.2)	−1.6 (−4.2 to 1)
eGFRcr-cys(AS), new	90.5 (88.1 to 92.9)	90.8 (89.9 to 91.8)	−0.3 (−3.0 to 2.4)

Cystatine C

Table 3. Accuracy of Current and New Approaches for GFR Estimation as Compared with Measured GFR in the Validation Data Set.

Filtration Marker and Equation*	Black Participants	Non-Black Participants	Difference between Black Participants and Non-Black Participants (95% CI)†
	Bias: Median Difference between Measured GFR and eGFR (95% CI)‡		
	milliliters per minute per 1.73 square meters		
	Agreement within 30% of Measured GFR (P_{30})§		
	percent		*percentage points*
Creatinine			
eGFRcr(ASR), current	85.1 (82.2 to 87.9)	89.5 (88.5 to 90.4)	−4.4 (−7.6 to −1.2)
eGFRcr(ASR-NB), new	86.4 (83.4 to 89.1)	89.5 (88.5 to 90.4)	−3.1 (−6.2 to 0)
eGFRcr(AS), new	87.2 (84.5 to 90.0)	86.5 (85.4 to 87.6)	0.7 (−2.4 to 3.8)
Cystatin C			
eGFRcys(AS), current	84.6 (81.7 to 87.6)	88.9 (87.9 to 89.9)	−4.3 (−7.5 to −1.1)
Creatinine–cystatin C			
eGFRcr-cys(ASR), current	88.6 (85.8 to 91.2)	92.4 (91.5 to 93.2)	−3.8 (−6.7 to −0.9)
eGFRcr-cys(ASR-NB), new	90.8 (88.4 to 93.1)	92.4 (91.5 to 93.2)	−1.6 (−4.2 to 1)
eGFRcr-cys(AS), new	90.5 (88.1 to 92.9)	90.8 (89.9 to 91.8)	−0.3 (−3.0 to 2.4)
	Percent Agreement between eGFR and Measured GFR Categories¶		
Creatinine			
eGFRcr(ASR), current	63.2 (59.3 to 67.1)	68.5 (67.0 to 70.1)	−5.3 (−9.6 to −1)
eGFRcr(ASR-NB), new	59.2 (55.2 to 63.2)	68.5 (67.0 to 70.1)	−9.3 (−13.7 to −4.9)
eGFRcr(AS), new	61.8 (57.9 to 65.8)	66.7 (65.1 to 68.2)	−4.9 (−9.3 to −0.5)
Cystatin C			
eGFRcys(AS), current	62.5 (58.6 to 66.5)	66.1 (64.5 to 67.7)	−3.6 (−8.0 to 0.8)
Creatinine–cystatin C			
eGFRcr-cys(ASR), current	67.9 (64.1 to 71.7)	70.8 (69.3 to 72.4)	−2.9 (−7.1 to 1.3)
eGFRcr-cys(ASR-NB), new	66.5 (62.6 to 70.3)	70.8 (69.3 to 72.4)	−4.3 (−8.6 to 0)
eGFRcr-cys(AS), new	68.4 (64.6 to 72.2)	70.2 (68.6 to 71.7)	−1.8 (−6 to 2.4)

REVIEWS

The applicability of eGFR equations to different populations

Pierre Delanaye and Christophe Mariat

Aujourd'hui, la question n'est pas tant de savoir quelle équation est la meilleure mais quand un recours au DFG mesuré est pertinent

Delanaye P, Nature Rev Nephrol, 2013, 9, 513

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

1.4.3.3: We recommend that clinicians (*1B*):

- 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.

Conclusions

- Le DFG estimé…reste une estimation
- Bien à l'échelle de la population
- Précision relativement limitée à l'échelle individuelle
- Nombreuses erreurs pour la classification (*staging*)
- Cystatine C a une valeur ajoutée (« race »/genre)
- Mesurer le DFG a encore sa place
- Mesurer le DFG n'est ni (si) difficile, ni (si) coûteux

Merci


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