

Bespreking van de Rondzendingen:

Eiwitten in de rondzending klinische chemie

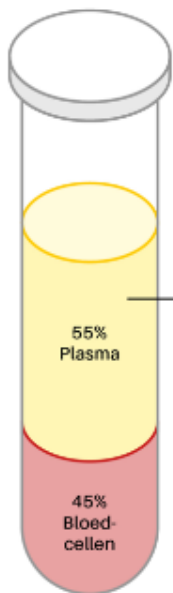
Miranda van Berkel, Sectie Algemene chemie
Radboudumc

Waarom meten we? Brain-to-brain



Wat meten we? analieten

Bloed



Plasma



Eiwitten

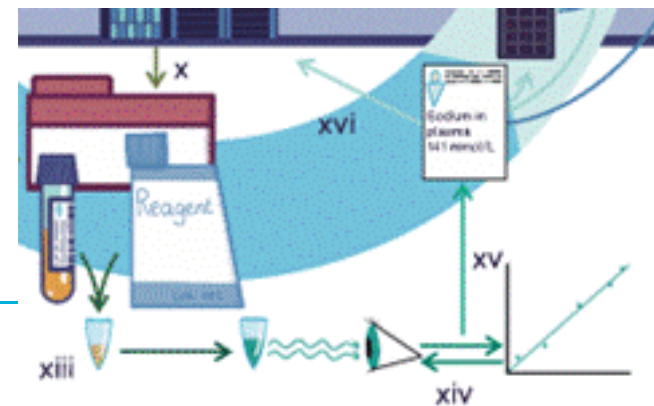
7% Eiwitten

3% Vetten, koolhydraten, afvalstoffen, elektrolyten

90% Water

25% Andere eiwitten

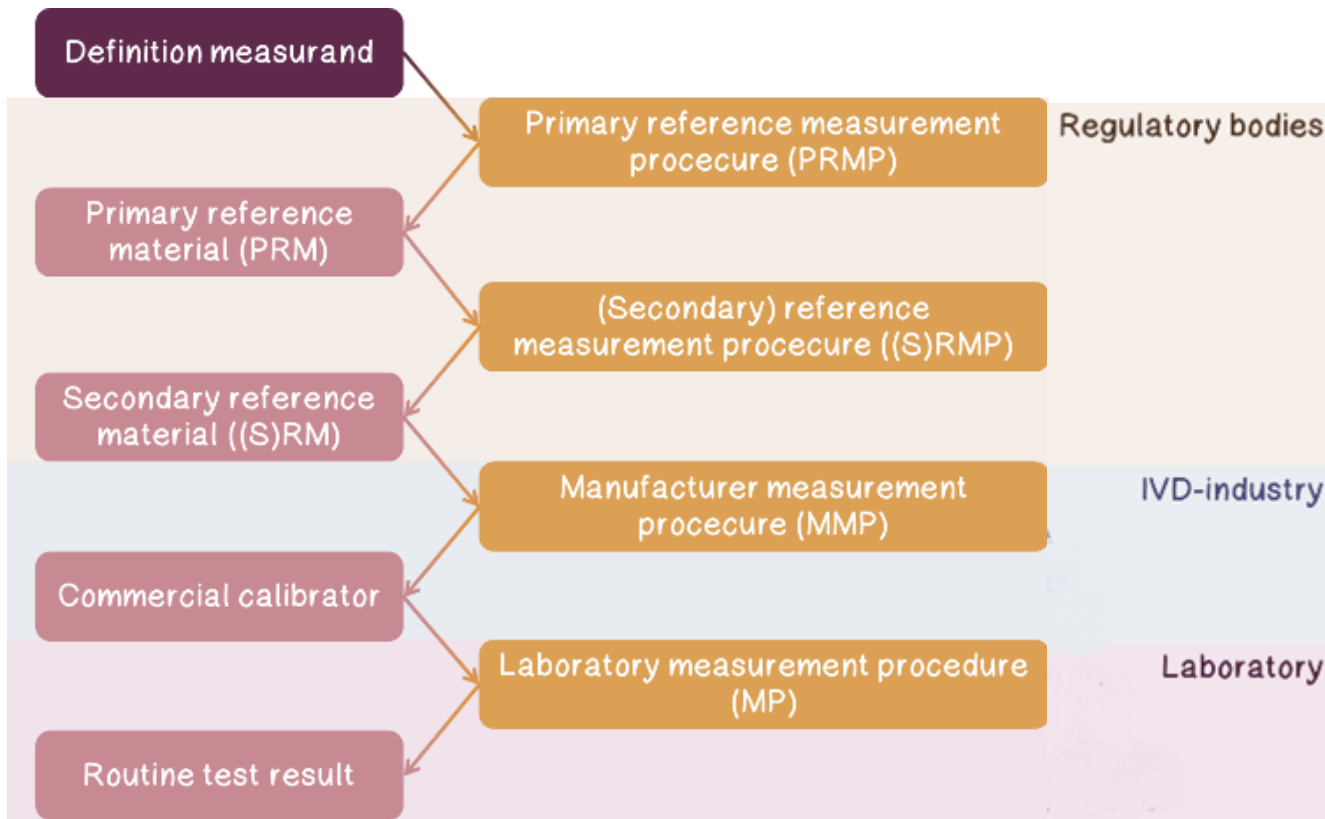
3% Stollingsfactoren
12% Antistoffen (Immunoglobuline G)



Doel sectie Algemene Chemie

- 1) Toezicht houden op de bias en imprecisie van de medische testen en afwijkingen van trends in prestaties van fabrikanten/methoden tijdig signaleren.
- 2) Bevorderen van standaardisatie van het total test program inclusief pre- en post analyse.

Juist? Metrologische traceerbaarheid



Analieten in de RZ algemene chemie

Klinische Chemie, bloed

ALAT

Albumine

Ammoniak

Anorg. Fosfaat

Bilirubine

Calcium

CK

Gamma-GT

Glucose

Kalium

Lactaat

Lipase

Magnesium

Osmolaliteit

Totaal Eiwit

Ureum

Alk. Fosfatase

Amylase

ASAT

Bilirubine direct

Chloride

eGFR (V, 55, blank)

Gecorrigeerd calcium

IJzer

Kreatinine

LD

Lithium

Natrium

Pseudo Cholinesterase

Uraat

Maar gelukkig...



MUSE

- pagina 2 van 25 -

10 januari 2024 18:00

Plasma-eiwitten 2023.4

C8000-1 (SKML)

Bepaling	Eenheid	Juistheid				Precisie		Performance			
		uw gem.	ref.	cons.	SDI1	uw SD	SDbl	deze ronde	PS	cumulaïef	PSc
C3	g/L	1.29	1.20	1.27	0.07	0.02	0.03		2		2
C4	g/L	0.240	0.262	0.242	0.009	0.006	0.007		1		0
IgG	g/L	8.85	8.63	9.03	0.32	0.16	0.17		2		2
IgA	g/L	2.07	1.98	2.02	0.06	0.04	0.04		1		1
IgM	g/L	0.800	0.798	0.814	0.037	0.014	0.030		2		2
IgG1	g/L	6.07		5.85	0.14	0.16	0.13				
IgG2	g/L	2.72		2.71	0.09	0.05	0.07				
IgG3	g/L	0.319		0.307	0.015	0.012	0.013				
IgG4	g/L	0.476		0.479	0.018	0.021	0.016				
Albumine	g/L	35.2	35.2	35.7	1.6	0.6	0.9		2		2
Ceruloplasmine	mg/L	253		268	14	12	9				
Transferrine	g/L	2.22	2.21	2.16	0.05	0.04	0.05		2		2
Ferritine	ug/L	164		165	6	3	5				
CRP	mg/L	6.61		6.80	0.30	0.20	0.21				
Haptoglobine	g/L	1.280	1.271	1.284	0.038	0.015	0.028		2		2
Bèta-2-microglobuline	mg/L	1.81	1.62	1.77	0.11	0.08	0.07		0		0
IgD	mg/L	27		23	2	2	2				

Casus

59 j vrouw met nefrotisch syndroom op basis van membraaneuze nefropathie

Voorgeschiedenis:

- 2014: hartoperatie ivm atrium septum defect
- diabetes mellitus type 2
- hypothyreoïdie
- visus stoornis rechts

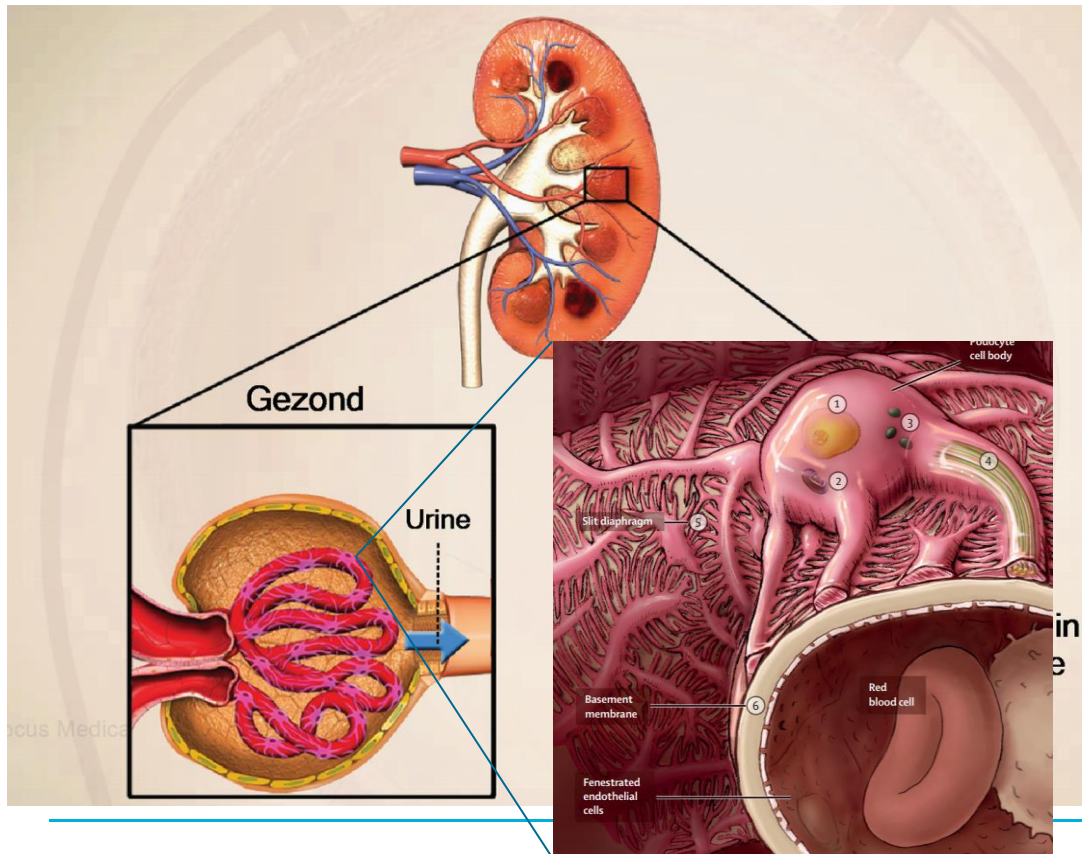
3 maanden na diagnose stelling verwijzing naar Radboud UMC voor advies behandeling

Nefrotisch Syndroom

- Een verzamelnaam van ziekten, waarbij de nier is beschadigd en er eiwitlekkage in de urine ontstaat
- Hierbij zijn de nierfilters (podocyten) beschadigd, waardoor proteïnurie ontstaat ($> 3,5$ gram/dg) en het albumine te laag wordt (< 30 g/l).
- Er lekken hierbij in principe geen cellen: geen hematurie of erythrocyten cilinders



Nefrotisch Syndroom: oorzaken



Primair	Secundair
'Minimal change'-nefropathie	Systemziekten – diabetes mellitus – amyloidose – systemische lupus erythematoses
Focale segmentale glomerulosclerose	Infectieus – hiv – hepatitis – lues
Membraneuze glomerulopathie	Medicamenteus
	Paraneoplastisch

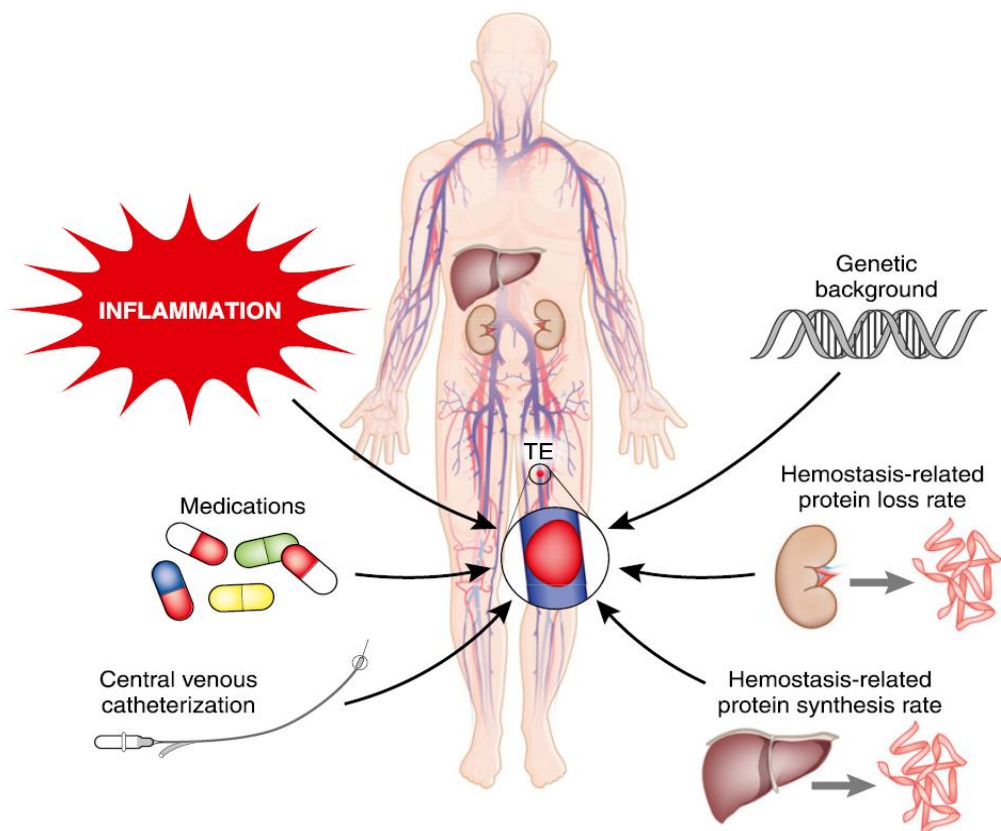
Nefrotisch Syndroom: Symptomen



- proteïnurie > 3,5 g/24 uur
- serumalbumine < 30 g/L
- perifeer oedeem

Bijkomend criterium is ernstige hyperlipidemie (totaal cholesterol > 10 mmol/L).

Nefrotisch Syndroom: risico veneuze trombose



	Hazard Ratio	P-value
<i>Albumine bij presentatie</i>		
> 38 g/l	Ref	
29-38 g/l	2.7	0.4
<29 g/l	9.6	0.03

Albumine als beslisfactor in nefrologie

Author and reference	Intended clinical use	Medical decision limit	Mentioned method
Diagnosis			
KDIGO CKD evaluation and treatment	Diagnosis hypoalbuminemia in CKD patients	< 35 g/L	NR
KDIGO Glomerulonephritis	Diagnosis of nephrotic syndrome in children Differentiation primary vs secondary FSGS	< 25 g/L < 30 g/L for primary vs ≥ 35 g/L for secondary	NR NR
Favus, KI 2008	To detect protein energy wasting in HD patients	< 28 g/L	BCG
Treatment and evaluation of treatment response			
KDIGO Glomerulonephritis	Use of anticoagulation in NS patients	Initiate at < 25 g/l Discontinue at ≥ 30 g/L	NR NR
Lee, KI 2014 (26)	Use of a risk calculator for the decision of prophylactic anticoagulation in patients with MN (biopsy proven)	In accordance to risk calculator	NR
Practice Guideline on Haemodialysis,	Use of high flux membranes in HD patients	< 40 g/L	NR/ BCG
KDIGO Glomerulonephritis	To evaluate treatment response in FSGS and MN	For FSGS ≥ 35 g/l For MN 'improvement or normalization'	NR NR
Prognostic value			
Mafra, Int Urol Nephrol 2007	To predict mortality in HD patients	35 g/l	BCG
Patzner, Transp, 2016	To predict mortality in HD patients	35 g/l	NR
Villain, JAGS 2016	To predict mortality of HD patients	38 g/l	NR
Couchoud, KI 2015	Use in a risk-calculator for mortality risk in patients over 75 when starting RRT	Gradual risk association	NR
MolNRr, Am J Transp, 2011	To predict mortality in patients elected for kidney transplantation	Gradual risk association	NR
Bansal, JASN, 2015	To predict risk of death within 5 years for non-dialytic patients with CKD stages 3-5	Gradual risk association	Nephelometry
Kurita, J of Renal nutrition 2017	To predict mortality in HD patients	38 g/l	NR

Casus

59 j vrouw met nefrotisch syndroom op basis van membraneuze nefropathie

Voorgeschiedenis:

- 2014: hartoperatie ivm atrium septum defect
- diabetes mellitus type 2
- hypothyreoïdie
- visus stoornis rechts

3 maanden na diagnose stelling verwijzing naar Radboud UMC voor advies behandeling

Laboratorium uitslagen

2 12-5-2016 10:00	
NIERFUNCTIE (BLOED...)	
Ureum	5.7
Kreatinine	95 ▲
EIWIT (BLOED)	
Albumine	15 ▼
Albumine nefelomet...	14.9 ▼
Beta-2-microglobuline	3.63 ▲
Eiwit	47 ▼

Alb elders : 25 gr/L

KDIGO richtlijn adviseert **antistolling bij serumalbumine < 25 g/l**
Recent hematuri en bloedstolsels in urine -> nog geen antistolling.

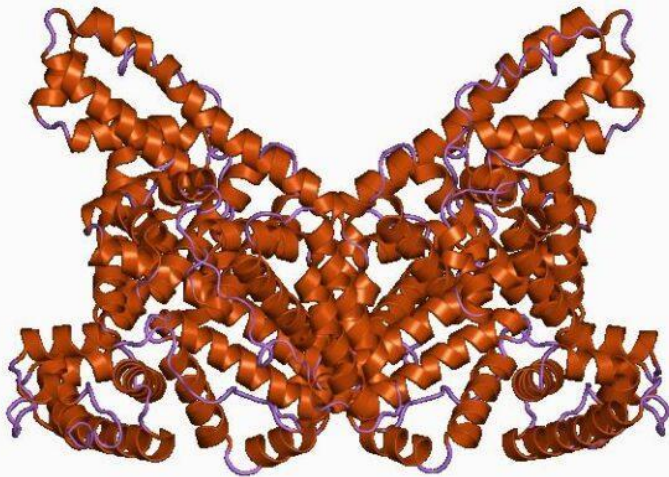
Aug: Alb meting elders: 21 gr/L

Advies: Start cyclophosphamide, prednison, LMWH

ECHTER: vlak daarvoor ischemisch CVA

Vershil in meetmethode!

Albumine



Vasculair oncotische druk

Metabool zuur-base buffer functie

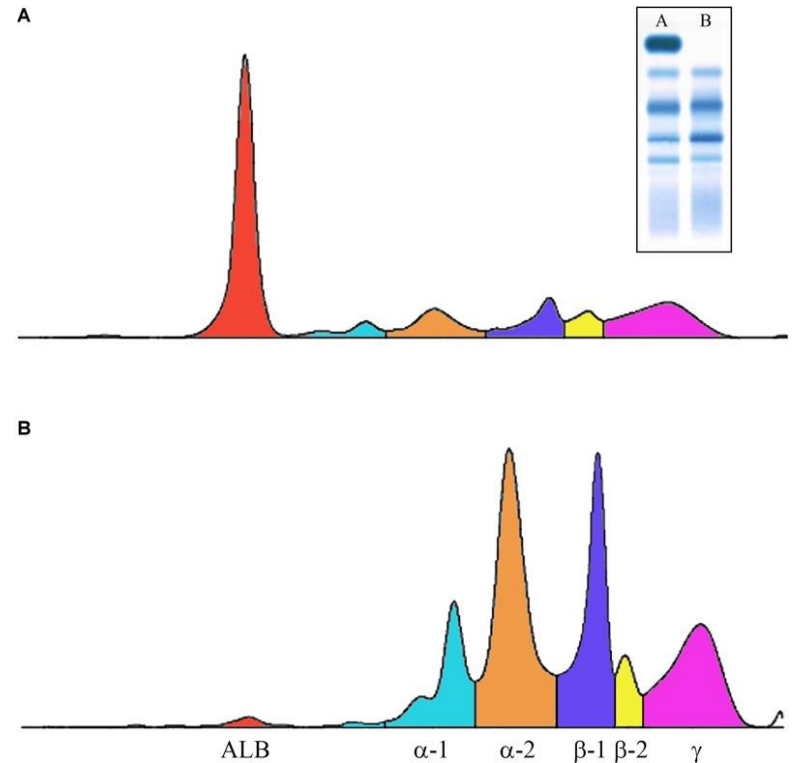
Transport

- Hormonen
- Vrije vetzuren
- Bilirubine
- Ca^{2+} , Mg^{2+}
- Medicijnen

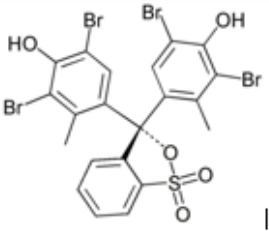
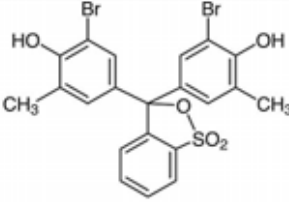

Albumine: fysiologie

Congenitale analbuminemie patiënt:

- A. normaal
- B. licht oedeem**
- C. zwaar oedeem

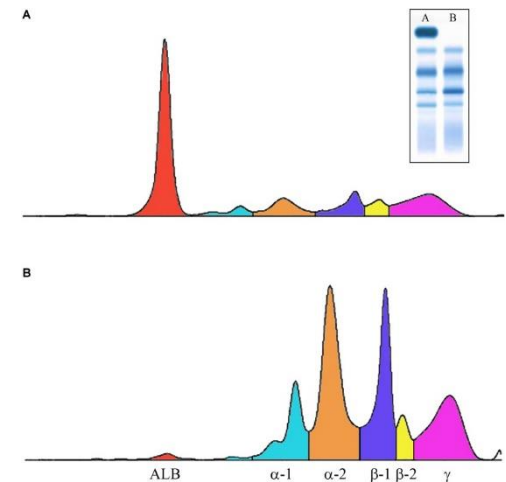


ALB assays

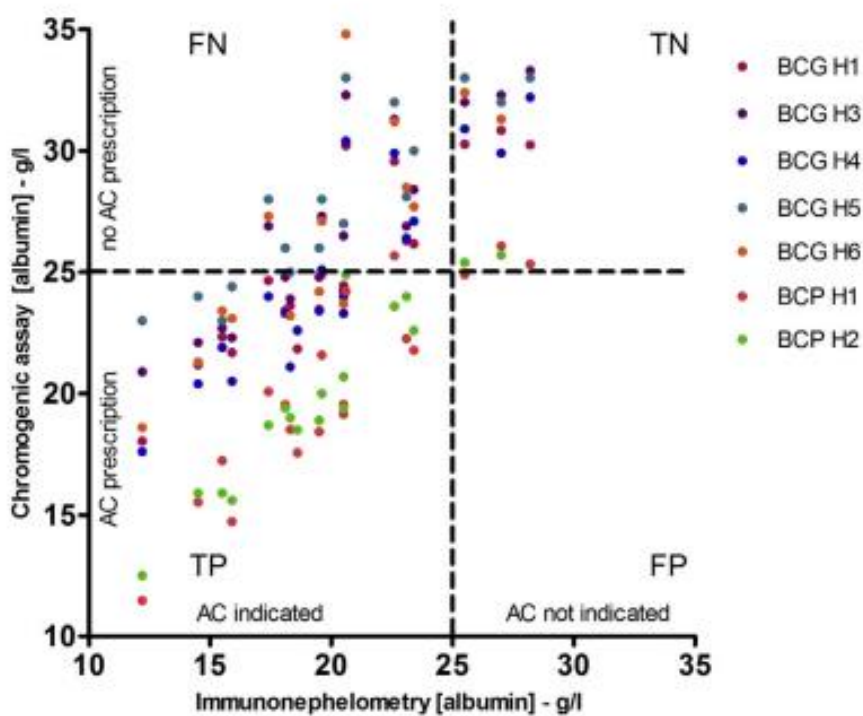
	Bromocresol green	Bromocresol purple	Nephelometry Turbidimetry
	 <p>Mw: 698,01 Da</p>	 <p>Mw: 540,24 Da</p>	 <p>Mw: ~150 kDa</p>
Assay	Bromocresol green	Bromocresol purple	<u>Immuno</u>
Specificity	<p>*</p> <p>Aspecific binding to $\alpha 1/ \alpha 2/B$ globulin</p>	<p>***</p> <p>Low aspecific binding <u>neg interference:</u> Uremic toxins Carbamylation</p>	<p>****</p> <p>Highly specific for albumin Few interferences</p>
Imprecision	<p>***</p> <p>Low within lab variation Higher between-lab variation</p>	<p>****</p> <p>Low within/between lab variation</p>	<p>***</p> <p>Low within lab imprecision Higher between lab variation</p>
Costs	****	****	**
Other	<p>***</p> <p>Some cut-off values established with BCG</p>	<p>**</p> <p>Not often used or stated in clinical studies</p>	<p>*/****</p> <p>limited 24/7 availability JCTLM as reference method</p>

Hoe hoog is de gemeten albumine in een analbuminemie patiënt?

- 0,049 gr/l met de nefelometer
- 14 gr/L (gemeten met BCG)
- < 8 gr/l (gemeten met BCP)
- Alle beweringen zijn juist**

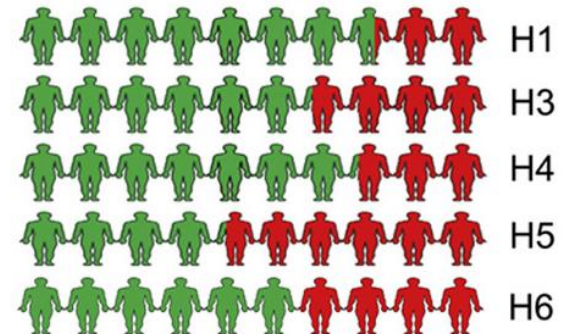


BCG albumine leidt tot onderbehandeling



n

Large bias between assays
→ Disagreement in treatment decisions

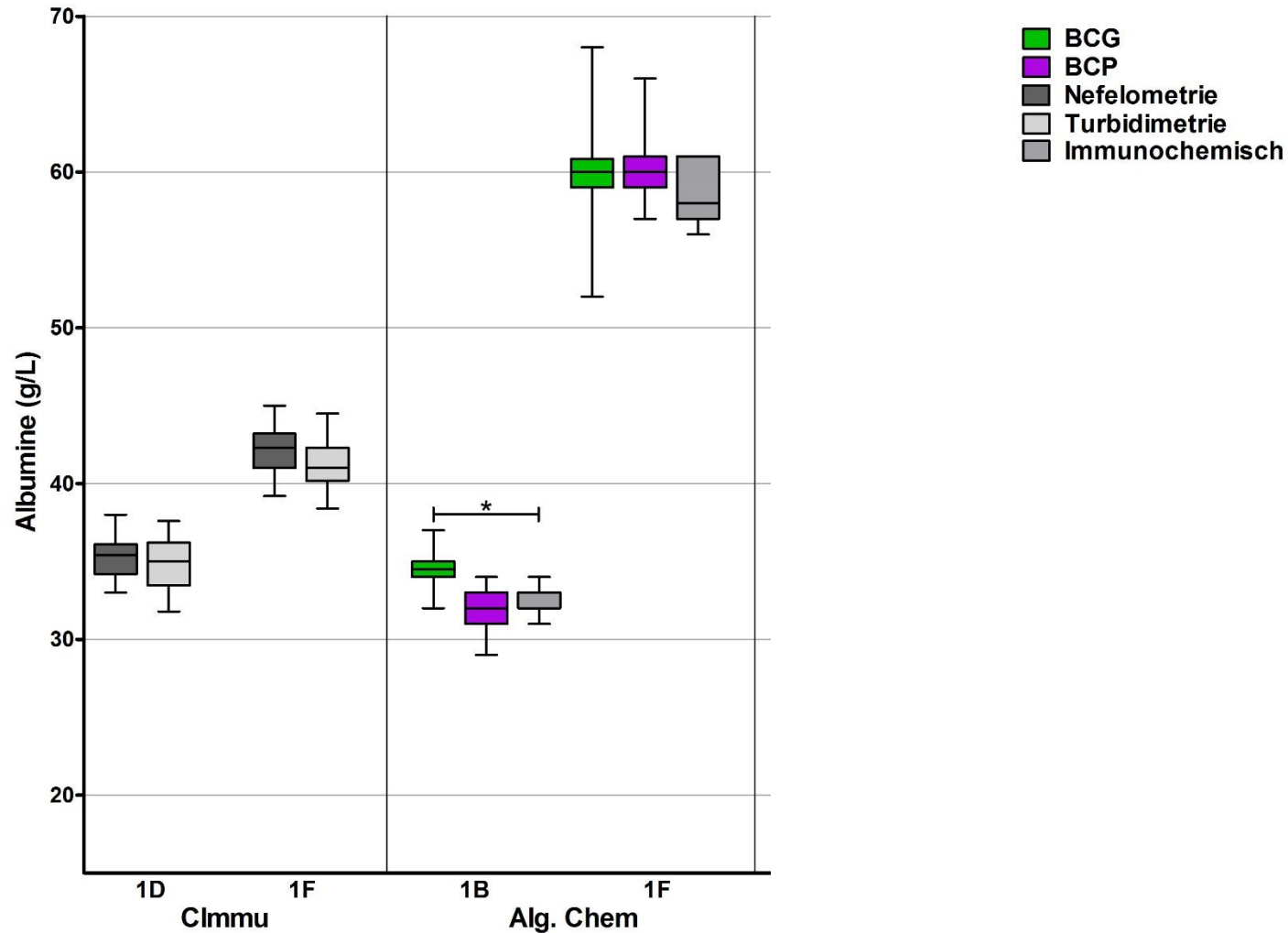


agreement disagreement

CONCLUSION:

Differences between albumin assays:
large impact on diagnosis and
treatment decisions in nephrology.

Vergelijkbaarheid BCP en BCG in EQC



Wat is juist?

- Consensus gemiddelde van de groep (ALTM)
- Doelwaarde vastgesteld door referentie methode
- Doelwaarde vastgesteld door methode gerelateerd aan referentie materiaal

Voorwaarden:

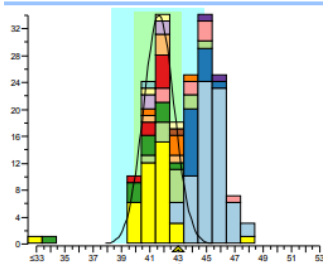
- EQC Materiaal is commuteerbaar
- Referentiemethode/materiaal is beschikbaar: ERM-DA470k/IFCC

Geschikt voor beoogd gebruik!

Albumine in de rondzendingen

Klinische chemie bloed

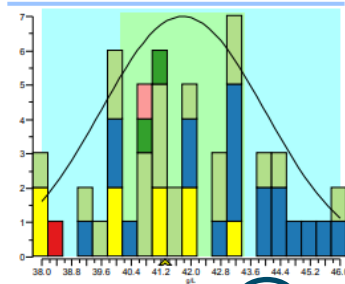
2019.1 A



	cons.	meth.	ALTM	lab
gem.	41.6	41.4	43.6	43
SD	1.1	0.9	2.4	
n	78	38	182	

Liquor

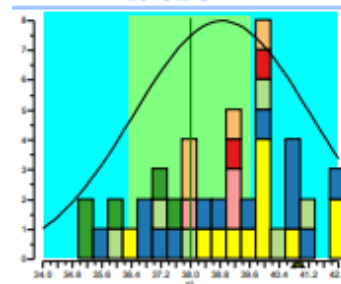
2019.1 B



	cons.	meth.	ALTM	lab
gem.	41.8	40.6	41.8	41.3
SD	2.2	1.8	2.2	
n	53	9	53	

Plasmaeiwitten

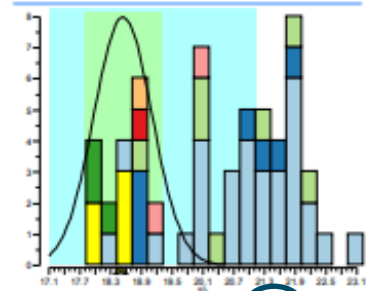
2019.2 C



	cons.	meth.	ref.	lab
gem.	38.9	39.8	38.0	40.9
SD	2.4	1.6		
n	17	12		

Neonatale bili

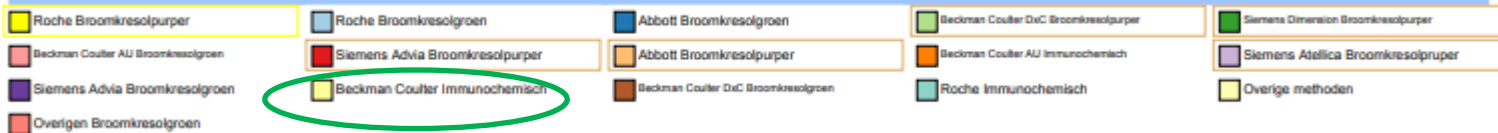
2019.2 E



	cons.	meth.	ALTM	lab
gem.	18.5	18.4	20.5	18.5
SD	0.6	0.3	1.7	
n	12	5	57	

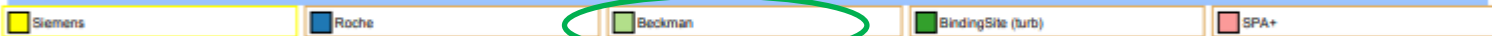
A

Legenda



B

Legenda



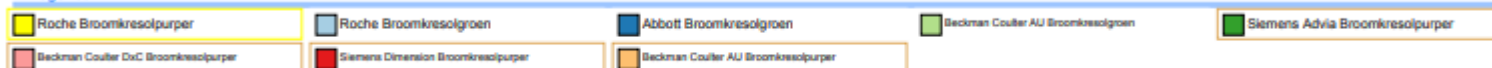
C

Legenda



D

Legenda



Juistheidsbepaling Albumine

- Referentie methode: 'Optimized immunoturbidimetry/immunonephelometry' *
- Referentie materiaal: ERM470k/IFCC

ERM[®] - DA470k/IFCC

HUMAN SERUM		
Proteins in the reconstituted material ¹⁾	Mass concentration	
	Certified value ²⁾ [g/L]	Uncertainty ³⁾ [g/L]
α_2 macroglobulin (A2M)	1.43 ⁴⁾	0.06
α_1 acid glycoprotein (AAG)	0.617 ⁵⁾	0.013
α_1 antitrypsin (AAT)	1.12 ⁵⁾	0.03
albumin (ALB)	37.2 ⁴⁾	1.2
β -2-microglobulin (B2M)	0.00217 ⁶⁾	0.00007
complement 3c (C3c)	1.00 ⁴⁾	0.04
complement 4 (C4)	0.162 ⁴⁾	0.007
haptoglobin (HPT)	0.889 ⁴⁾	0.021
immunoglobulin A (IgA)	1.80 ⁴⁾	0.05
immunoglobulin G (IgG)	9.17 ⁴⁾	0.18
immunoglobulin M (IgM)	0.723 ⁴⁾	0.027
transferrin (TRF)	2.36 ⁵⁾	0.08
transthyretin (TTR)	0.220 ⁵⁾	0.018

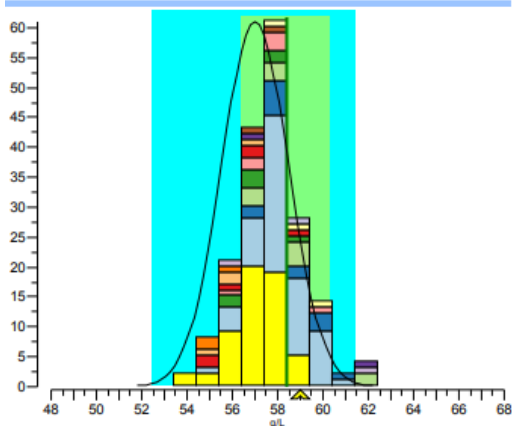
* JCTML listed

Albumine: doelwaarde & 'fit for purpose'

- Nefelometrische methode
- Gekalibreerd met ERM470k/IFCC
- Samples SKML in 4-plo gemeten

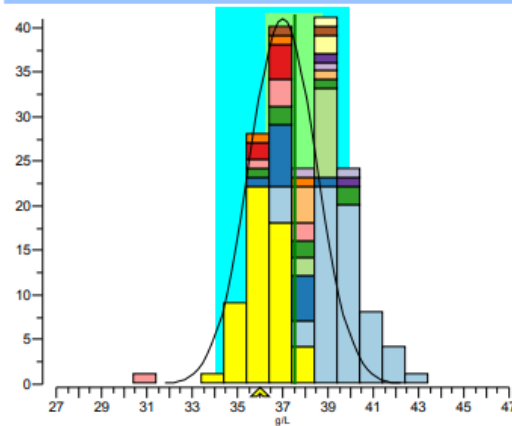
Rondzending met serum patienten NS

2023.1 F



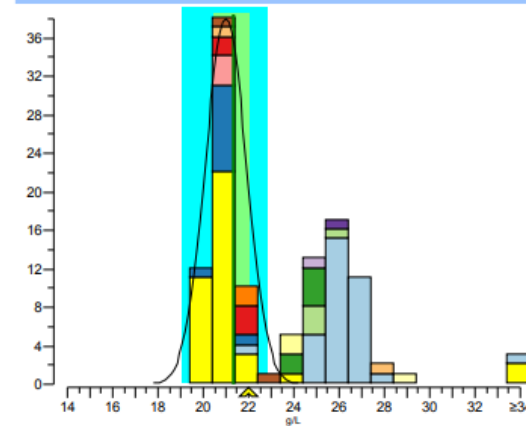
	cons.	meth.	exp.	lab
gem.	57.0	57.2	58.4	59
SD	1.5	1.1		
n	91	57		
nu	1	0		
rec.	104%	103%	101%	

2023.1 E



	cons.	meth.	exp.	lab
gem.	37.0	36.3	37.5	36
SD	1.5	0.9		
n	88	54		
nu	1	0		
rec.	97%	99%	96%	

2023.1 G

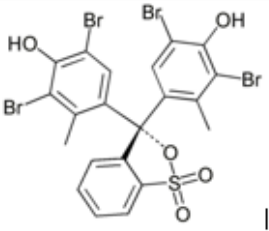
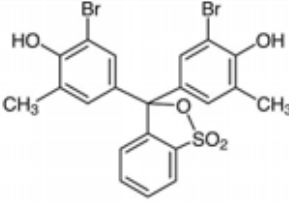



	cons.	meth.	exp.	lab
gem.	21.0	20.9	21.3	22
SD	0.9	0.8		
n	63	39		
nu	2	2		
rec.	105%	105%	103%	

Conclusies Albumine

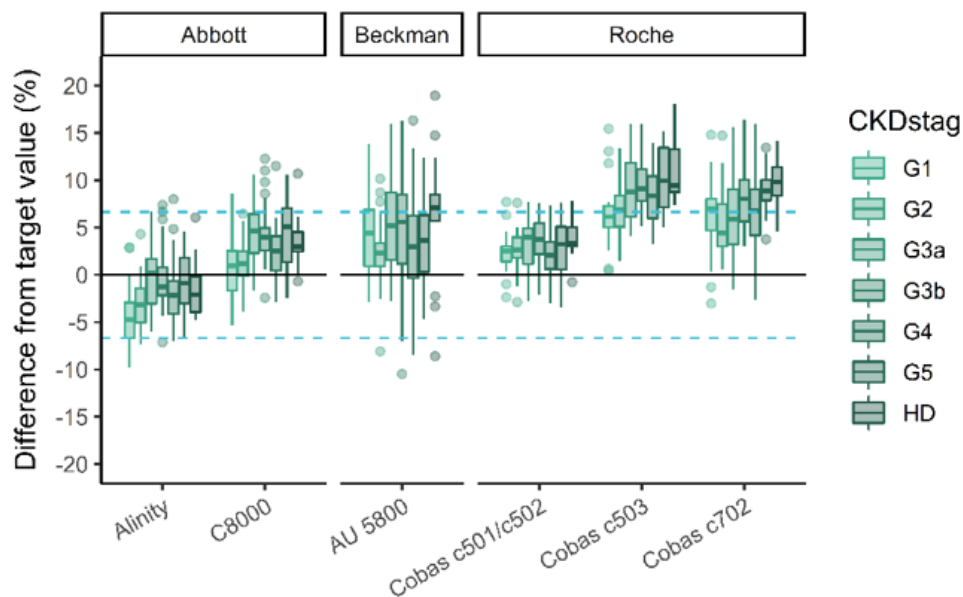
- EQA goed voor het beoogd gebruik
- Doelwaarde vaststellen is essentieel
- Harmoniseren albumine methoden
BCG uitfaseren!

ALB assays

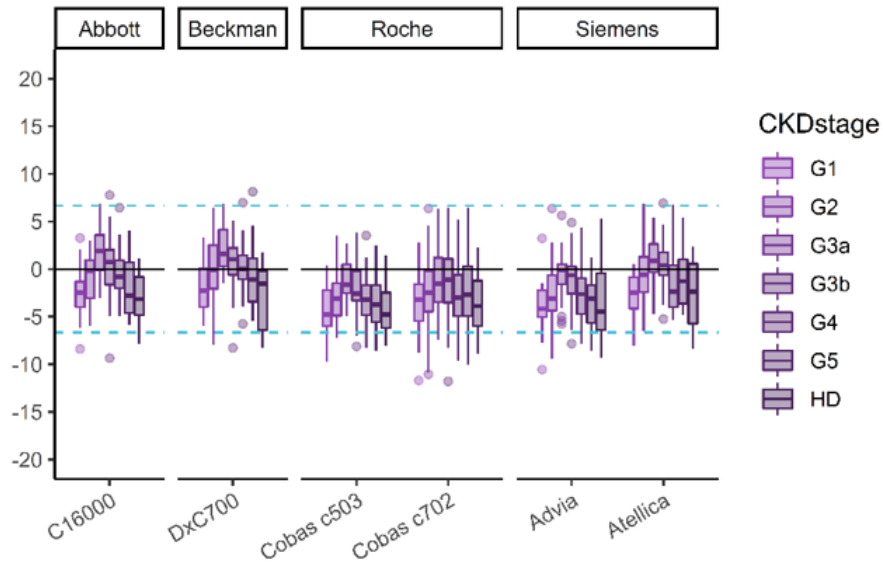
	Bromocresol green	Bromocresol purple	Nephelometry Turbidimetry
	 <p>Mw: 698,01 Da</p>	 <p>Mw: 540,24 Da</p>	 <p>Mw: ~150 kDa</p>
Assay	Bromocresol green	Bromocresol purple	<u>Immuno</u>
Specificity	<p>*</p> <p>Aspecific binding to $\alpha 1/ \alpha 2/B$ globulin</p>	<p>***</p> <p>Low aspecific binding <u>neg interference:</u> Uremic toxins Carbamylation</p>	<p>****</p> <p>Highly specific for albumin Few interferences</p>
Imprecision	<p>***</p> <p>Low within lab variation Higher between-lab variation</p>	<p>****</p> <p>Low within/between lab variation</p>	<p>***</p> <p>Low within lab imprecision Higher between lab variation</p>
Costs	****	****	**
Other	<p>***</p> <p>Some cut-off values established with BCG</p>	<p>**</p> <p>Not often used or stated in clinical studies</p>	<p>*/****</p> <p>limited 24/7 availability JCTLM as reference method</p>

Beoogd gebruik: pt met CKD

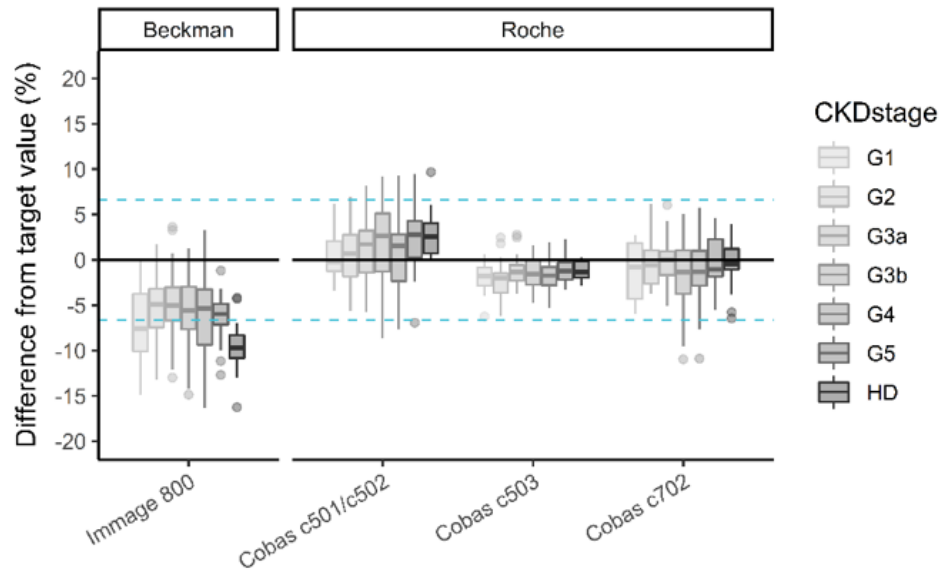
a. BCG



b. BCP



c. Immunological



Richtlijn 'glomerular disease'

Nephrotic syndrome	Nephrotic range proteinuria	Non-nephrotic range proteinuria
Proteinuria (adults)* • ≥ 3.5 g per 24 h • PCR ≥ 3000 mg/g (≥ 300 mg/mmol)	Proteinuria (adults) • ≥ 3.5 g per 24 h • PCR ≥ 3000 mg/g (≥ 300 mg/mmol)	Variable levels of proteinuria • 0.3–3.4 g per 24 h • PCR < 300 mg/g (< 300 mg/mmol)
Proteinuria (children)* • ≥ 40 mg/m ² /h • ≥ 300 mg/dl • 3+ on urine dipstick	Proteinuria (children) • ≥ 40 mg/m ² /h • ≥ 300 mg/dl • 3+ on urine dipstick	• Serum albumin normal • No clinical symptoms
• Hypoalbuminemia [†] • Edema [‡] • Hyperlipidemia [‡]	• Serum albumin usually normal • Edema is usually absent or minor • Serum lipids usually normal or only mildly elevated	

Find

albumin

Previous

*Essential

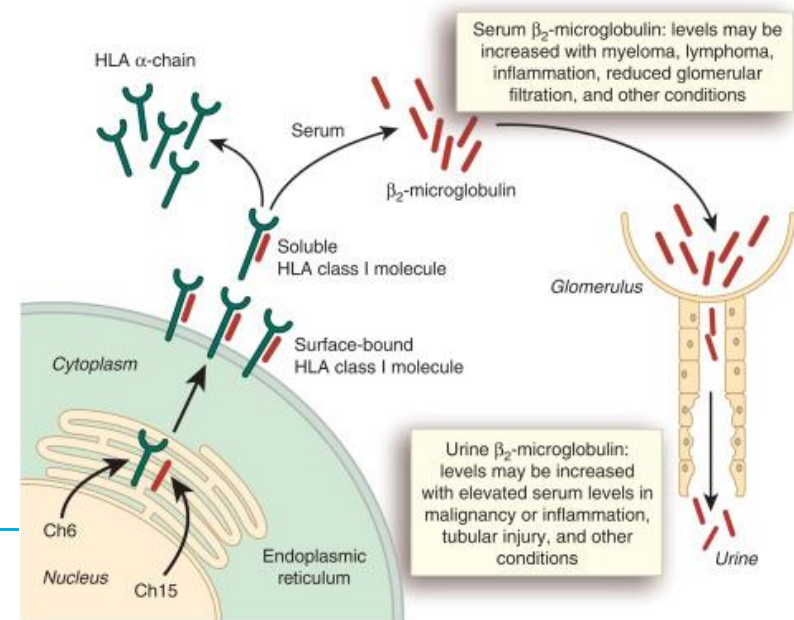
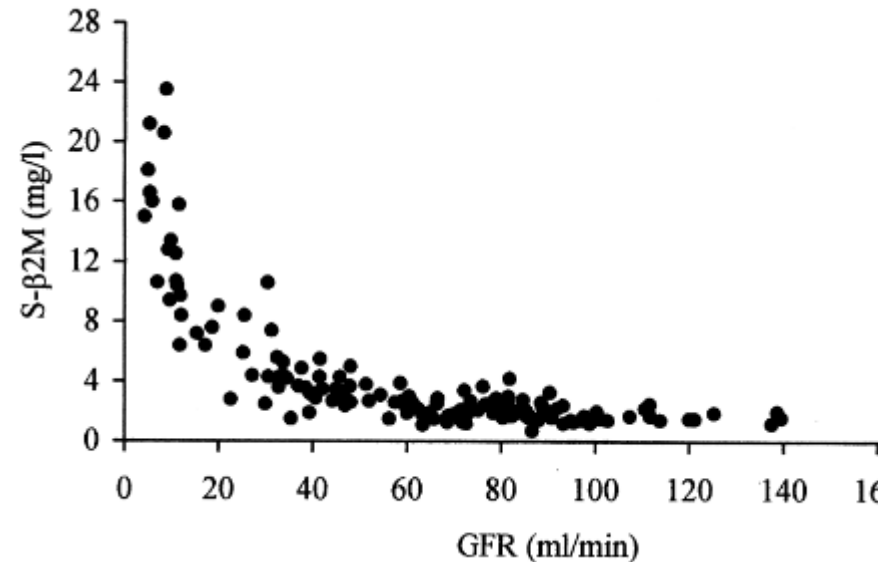
[†]Laboratory-specific values: Serum albumin should be measured by bromocresol purple (BCP; colorimetric) capillary electrophoresis (CE), or immunonephelometric (iMN) methods). Bromocresol green (BCG) methods can give erroneously high results. (see Clase *et al.*³⁹) The values of serum albumin measured by BCG are about 5.5g/l higher than those measured by BCP, CE, or iMN methods, so that the definition of the degree of hypoalbuminemia required to meet a definition of nephrotic syndrome varies according to the method used for quantifying serum albumin concentration.

[‡]

B2MG in bloed

- 11,8 kDA
- Onderdeel classe I HLA
- constante productie van 150-200 mg per dag
- Maat voor de nierfunctie
- Verhoogd bij infecties, autoimmuun ziekten, maligniteiten
- Prognose, beloop bij B cell maligniteit

Klinische afkapwaarden;
<4mg/l voor good prognostic MM
Stadium 1 <3,5 mg/L
Stadium III >5,5 mg/L

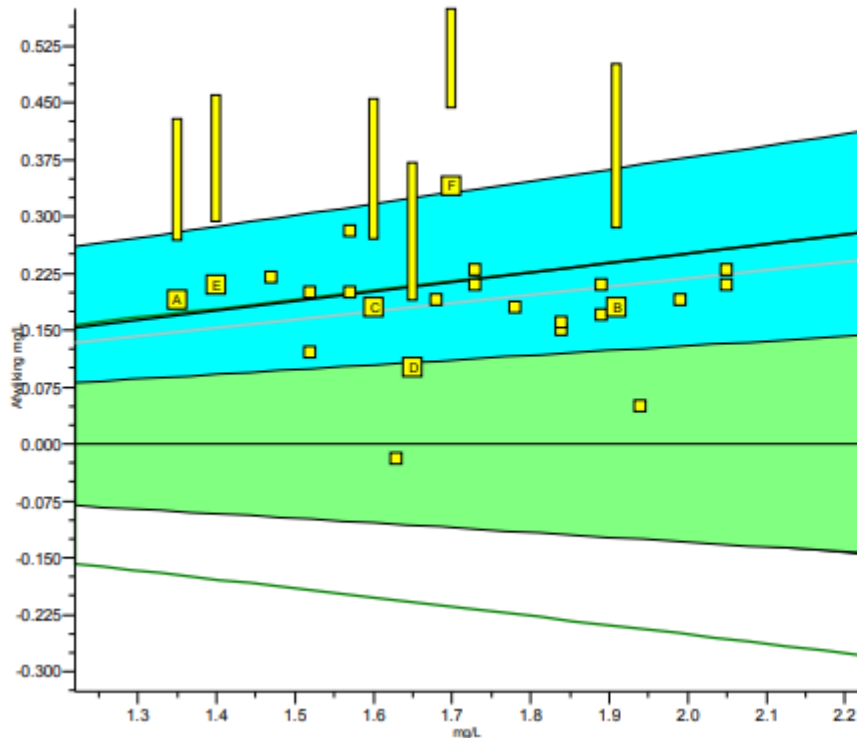


B2MG in bloed

Klinische afkapwaarden;
 <4mg/l voor good prognostic MM
 Stadium 1 <3,5 mg/L
 Stadium III >5,5 mg/L

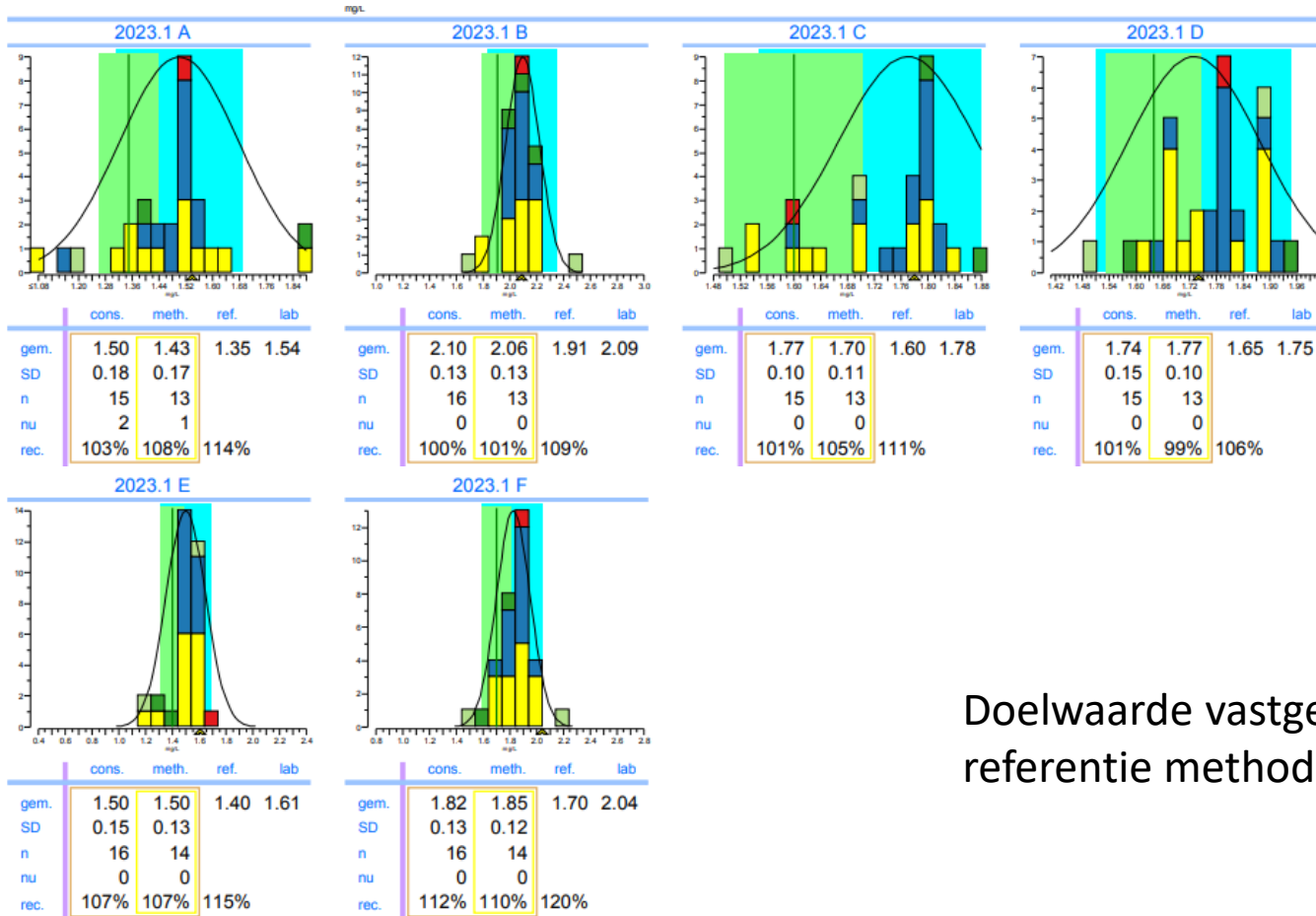
Bèta-2-microglobuline

eenheid : mg/L



	2023.1	cumulatief
Juistheid	+13%	+11%
Precisie	5.2%	4.3%
Aantal	6	24
Uitbijters	0	0
Sigma-TE	-0.6	-0.2
Sigma-SA	0.8 0	1.2 0
Scorepictogram		
Regressielijn	$0.00 + 1.126 \cdot x$	$0.00 + 1.109 \cdot x$
Consensusgroep	Siemens	
Methode	Siemens (nefel)	
Analyser	Siemens Atellica Neph630	
Uw factor	$0.00 + 1.000 \cdot x$	
Methodefactor	$0.00 + 0.984 \cdot x$	

B2MG in bloed: wat is juist?



Doelwaarde vastgesteld door de referentie methode?

Legenda



Communicatie

Sectie Humorale immunologie

Dr. A.J.A. Lambeck

Radboud Universiteit
Mercator 2
Toernooiveld 300
NL-6525 EC Nijmegen
Tel : +31 24 361 66 37
E-mail : office@skml.nl

Datum : 22 februari 2023
Onderwerp : Doelwaarde C3 en beta-2-microglobuline

Geachte deelnemer,

In 2022 zijn er vragen geweest over de doelwaarde van zowel C3 als beta-2-microglobuline (b2m) in de rondzending plasma-eiwitten. Aanleiding van die vragen is het feit dat deelnemers zien dat geen van alle methoden de doelwaarde terugvindt. Zie onderstaande voorbeelden uit rapporten voor resp. C3 en b2m.

Overdracht van de doelwaarde van het referentiemateriaal op de SKML monsters

De manier waarop de doelwaarde van de verschillende SKML rondzendmonsters is gebaseerd op die van het enkele ERM470 monster is als volgt. Door de SKML monsters tegelijk te meten met ERM-DA470k kan de waarde SKML monsters toegekend worden volgens:

$$\text{Doelwaarde SKML} = (\text{meetresultaat SKML}) * (\text{doelwaarde ERM-DA470k}) / (\text{meetwaarde ERM-DA470k})$$

De meetwaarden zijn daarbij gebaseerd op het gemiddelde van viervoudige metingen op een viertal laboratoria die elke een andere van de vier meest gebruikte methoden gebruiken. De doelwaarde die op deze wijze per platformtype wordt berekend is vrijwel identiek tussen de platforms. Voor de uiteindelijke doelwaarde van de SKML monsters worden de vier methodespecifieke doelwaarden nog gemiddeld.

Juistheidsbepaling B2MG

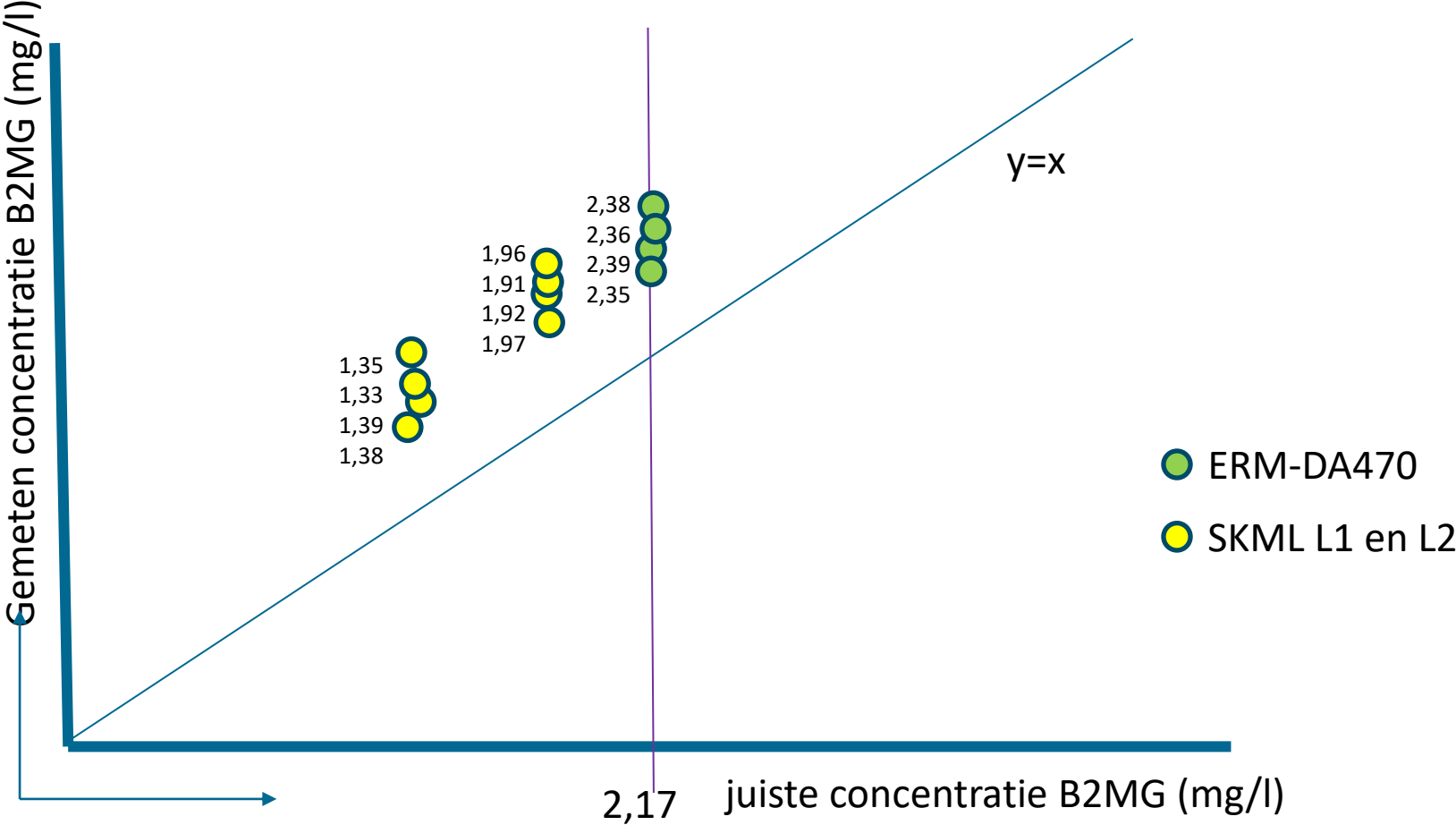
- Referentie materiaal: ERM-DA470k/IFCC

ERM[®] - DA470k/IFCC

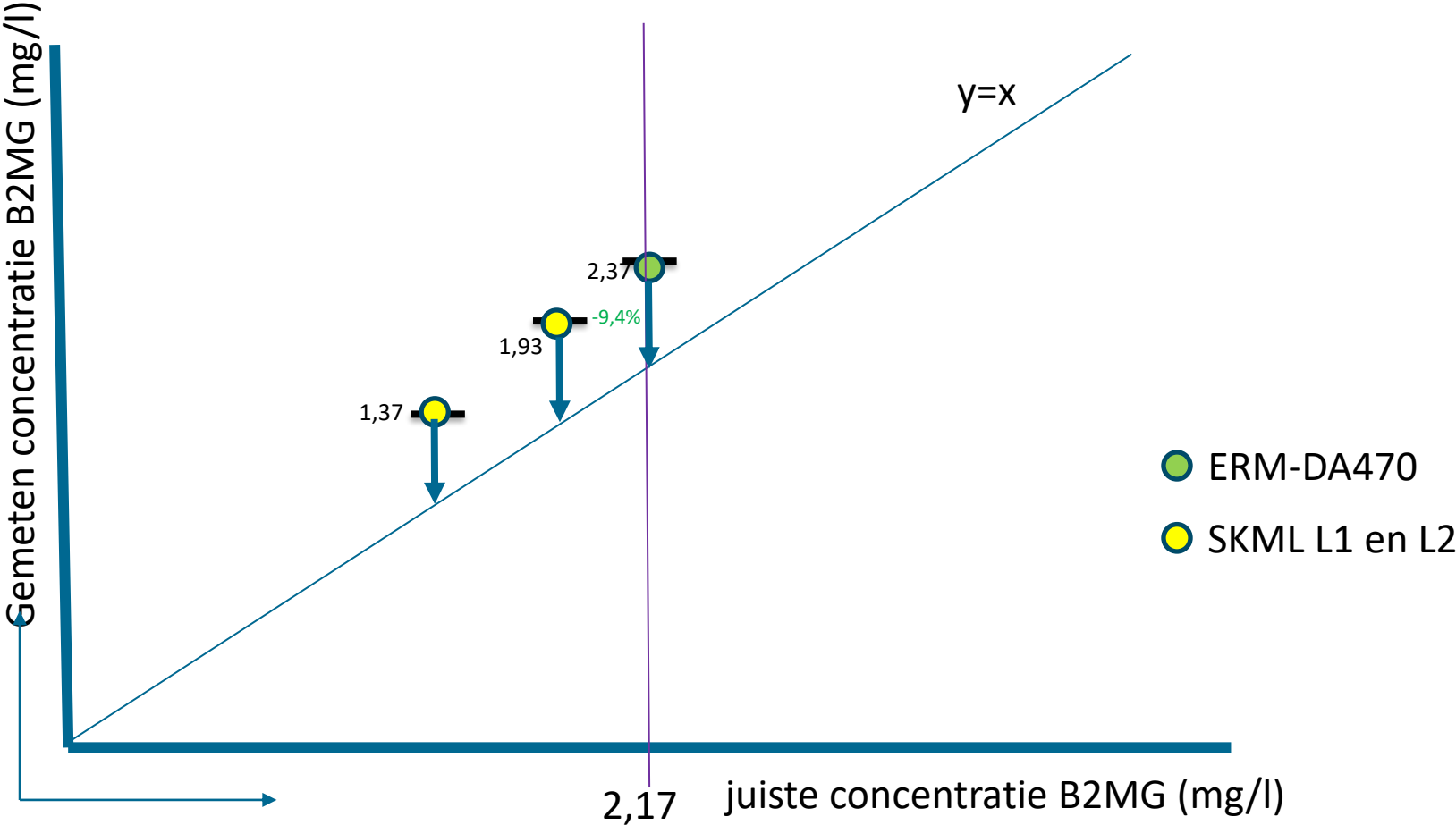
HUMAN SERUM		
Proteins in the reconstituted material ¹⁾	Mass concentration	
	Certified value ²⁾ [g/L]	Uncertainty ³⁾ [g/L]
α_2 macroglobulin (A2M)	1.43 ⁴⁾	0.06
α_1 acid glycoprotein (AAG)	0.617 ⁵⁾	0.013
α_1 antitrypsin (AAT)	1.12 ⁵⁾	0.03
albumin (ALB)	37.2 ⁴⁾	1.2
β -2-microglobulin (B2M)	0.00217 ⁶⁾	0.00007
complement 3c (C3c)	1.00 ⁴⁾	0.04
complement 4 (C4)	0.162 ⁴⁾	0.007
haptoglobin (HPT)	0.889 ⁴⁾	0.021
immunoglobulin A (IgA)	1.80 ⁴⁾	0.05
immunoglobulin G (IgG)	9.17 ⁴⁾	0.18
immunoglobulin M (IgM)	0.723 ⁴⁾	0.027
transferrin (TRF)	2.36 ⁵⁾	0.08
transthyretin (TTR)	0.220 ⁵⁾	0.018

* JCTML listed

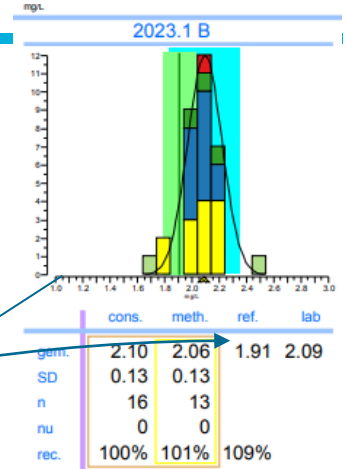
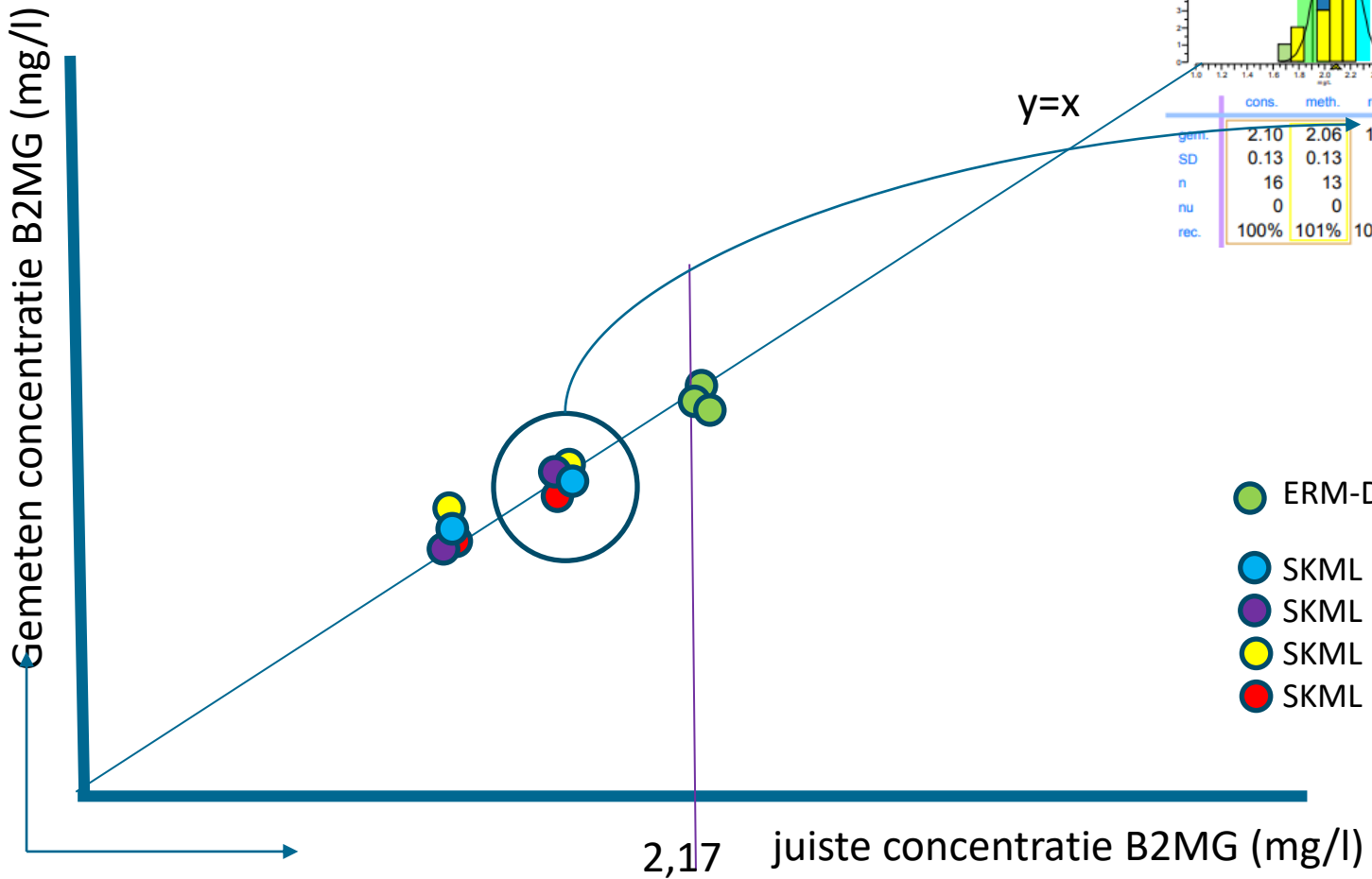
B2MG in plasma eiwitten RZ



B2MG in plasma eiwitten RZ



B2MG in plasma eiwitten RZ



- ERM-DA 470
- SKML Lab 1
- SKML Lab 2
- SKML Lab 3
- SKML Lab 4

Vaststelling doelwaarde B2MG

- Drie verschillende platforms meten SKML en ERM-DA470
- Gemiddelde waarde van de SKML monsters wordt gecorrigeerd voor de waarde die wordt gemeten in ERM-DA470 ($t = 2,17 \text{ mg/l}$)

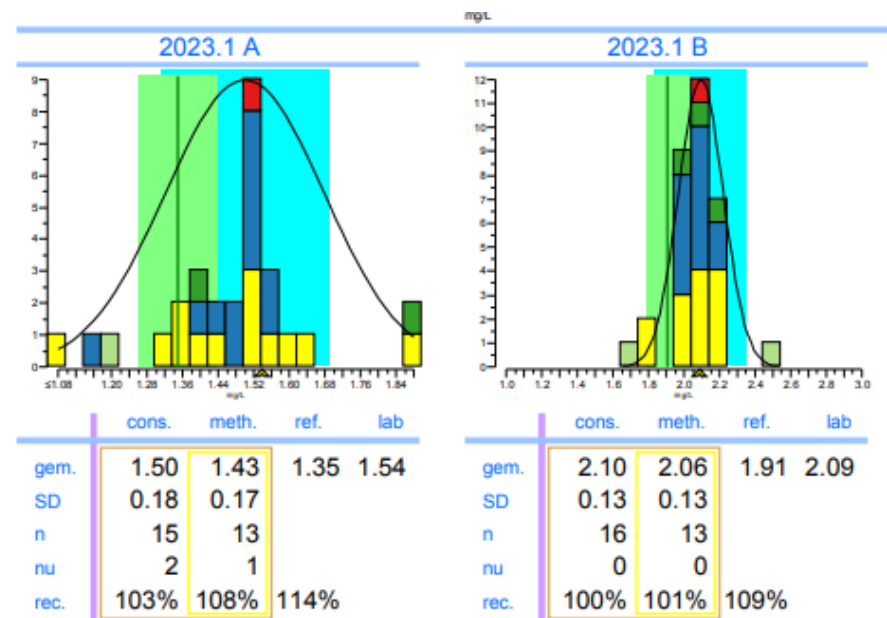
Lab	ERM470	Bias	SKML L1	SKML L2
1	2,13	-2%	1,37	1,93
2	2,32	+ 7%	1,40	2,03
3	2,38	+ 10%	1,46	2,04

Lab	SKML L1	SKML L2
1	1,39	1,97
2	1,31	1,90
3	1,34	1,87
Xgem	1,35	1,91

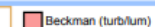
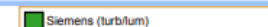
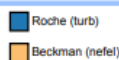
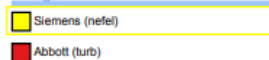
Vaststelling doelwaarde B2MG

- Drie verschillende platforms meten SKML en ERM-DA470
- Gemiddelde waarde van de SKML monsters wordt gecorrigeerd voor de waarde die wordt gemeten in ERM-DA470 ($t = 2,17 \text{ mg/l}$)

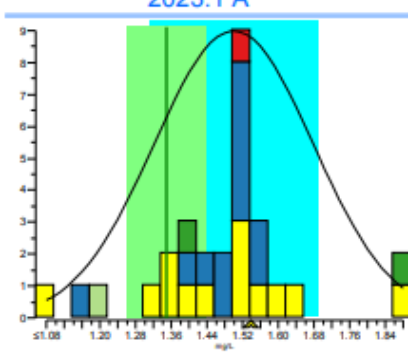
	ERM-DA470 (mg/l)	Bias
Siemens Atellica	2,13	-2%
Siemens BNprospec	2,32	+ 7%
Roche	2,38	+ 10%



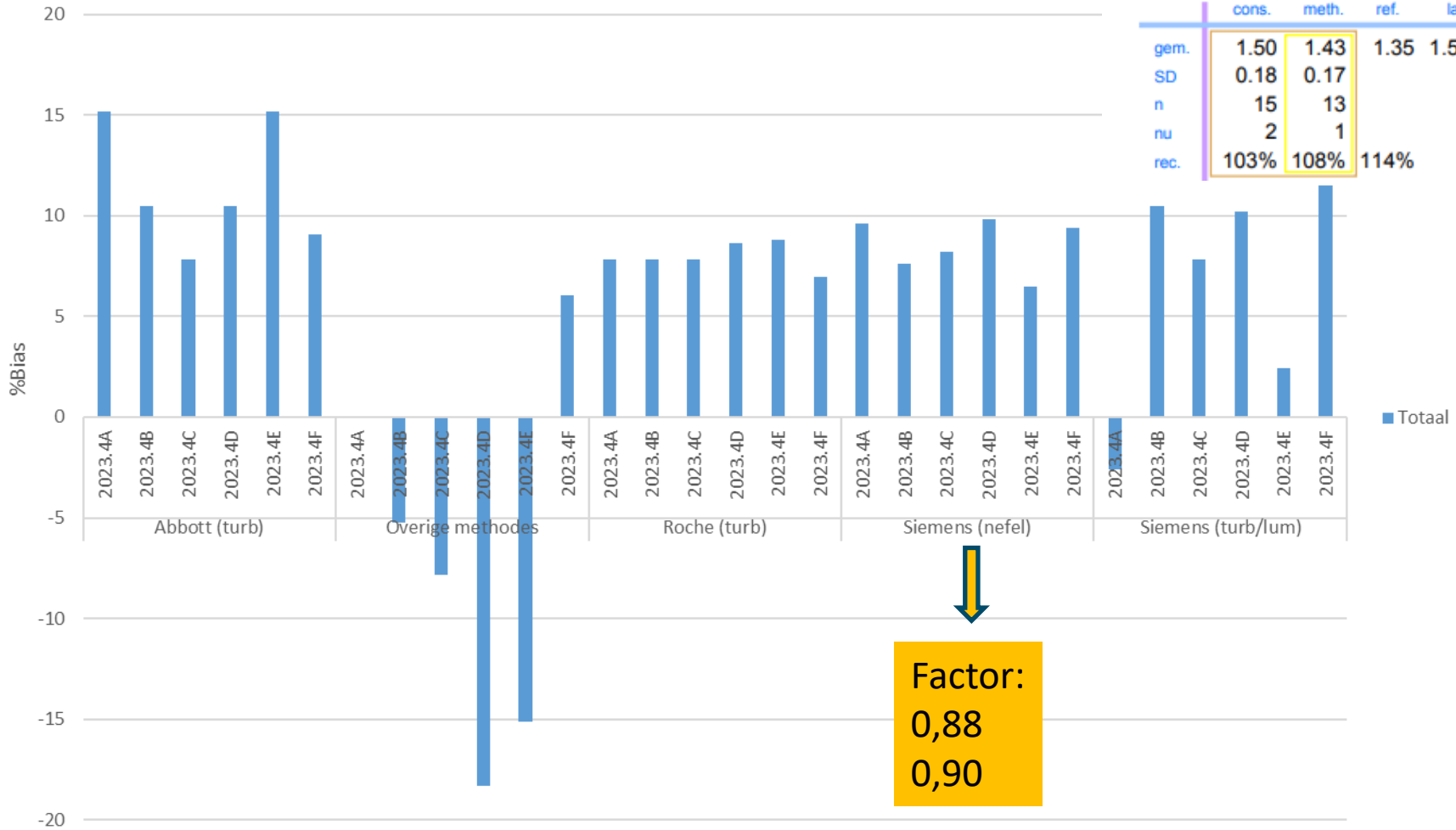
Legenda



Bias van de methoden



Gemiddelde van %bias



	cons.	meth.	ref.	lab
gem.	1.50	1.43	1.35	1.54
SD	0.18	0.17		
n	15	13		
nu	2	1		
rec.	103%	108%	114%	

Factor:
0,88
0,90

Conclusies B2MG

- Overwegend positieve bias van B2MG
- Metrologische traceerbaarheid gebaseerd op een WHO preparaat ipv IFCC listed referentie materiaal ERM470
- Tussentijd? Factor?

Siemens Healthcare Diagnostics Products GmbH
Emil-von-Behring-Str. 76
35041 Marburg, Germany



Certificate of Traceability Assigned Values

This is to certify the traceability of the assigned values of the product listed below to a reference material.

The uncertainty of the assigned value for this product was calculated according to the ISO norm 17511 by using a coverage factor of two.

Product	N Protein Standard SL
REF or Product Code	OQIM
Parameter	β 2- Microglobulin (Urine)
Reagent	N Latex β 2-Microglobulin
System(s) for usage of assigned value(s)	BN Systems, Atellica NEPH 630 System
Unit	mg/L
Reference material	1st International Standard for Beta2 Microglobulin (B2M)
Expanded Uncertainty of assigned value(s) [%]	3.1
Maximum allowable Uncertainty [%]	10.0

WHO International Standard
The 1st International Standard for Beta2 Microglobulin
NIBSC code: B2M
Instructions for use
(Version 6.0, Dated 04/04/2008)

Contact leverancier

Communicatie van de Siemens Healthineers Global Call Plasma Proteins

Analyte	Traceability
IgG, IgA, IgM, C3c, C4, Transferrin, Albumin, α_1 -Antitrypsin, α_2 -Macroglobulin, Haptoglobin, α_1 -acid Glycoprotein, Prealbumin, β_2 -Microglobulin	ERM-DA470k/IFCC ^{1,2,3}

Implementation is planned for Oct – Dec 2024 (depending on production data).
The measuring range will be the same and values should not change.
However – we will have better traceability – the bias vs. other methods might be reduced.

Dank aan:

Radboud laboratorium voor Diagnostiek, Nijmegen

- Dr. Sanna Rijpma
- Elma Prudon-Rosmulder

SKML Nijmegen

- Drs. Marith van Schrojenstein- Lantman
- Prof. Marc Thelen
- Dr. Chris Ramakers

Afdeling Nefrologie

- Prof. Jack Wetzels
- Drs. Anne-Els van der Logt
- Drs. Coraline Vink