



# Quality control in a small laboratory: added value of The Percentiler ?

Empower IVD globe workshop 09/12/2015

A-S Decavele

1. Introduction: Hospital Sint Andries – Clinical laboratory
2. Chemistry lab: QC
3. Chemistry lab: IQC
  - 3.1 Daily FU IQC
  - 3.2 Monthly FU IQC
  - 3.4 Intermediate FU
4. Patient percentile monitoring
5. Conclusions

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# 1. Introduction (1)



Clinical  
laboratory  
(sept 15)

Small regional hospital  
Tielt, West - Flandres

Medical activity:

- 266 beds hospitalisation + 36 day care hospital
- Physicians (2014): 75
- Personnel (2014): 662

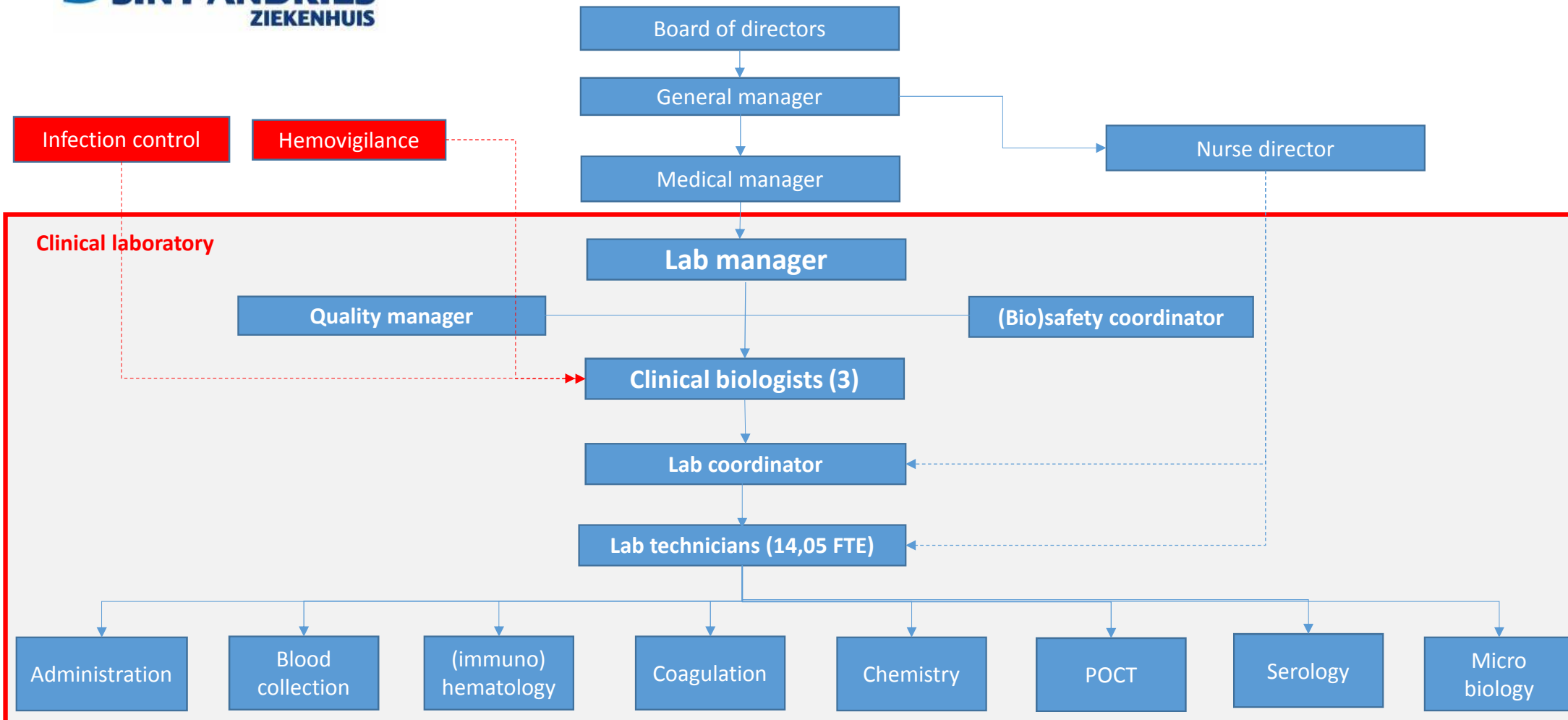
Clinical laboratory:

Medical activity:

6500 lab requests/month

3 clinical biologists

# 1. Introduction (2)



# 1. Introduction (3) chemistry lab



Cobas 6000: c501, e601

Cobas e411

Iricell

Osmometer

Phadia Unicap 250

Hydrasis



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## 2. Chemistry lab : QC

### **iQC**

Commercial control material

3rd party

2 levels in function of reference values en clinical relevance analytes

Peer group processing

Unity Real time

### **eQC**

EKE WIV

Master comparison

-> Cost – benefit ?



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## 3. Chemistry lab : IQC (1)

### PRECISION

New lot QC in parallel with old lot QC

- \* multiquant control: min. 20 points
- \* other QC : min 5 points (1-2x/dag, 5 days);  
recalculation after at least 20 points

-> Target mean = calculated mean -> URT: fixed  $\mu$

-> target SD = historical & realistic SD -> URT: fixed SD

### BIAS

Cumulative mean peer group (large # labs) or target  
package insert

### TEa :

1° TEa Ricos (BV) optimum, desirable of minimum

2° Medical relevance

- \* d (cfr. WIV)
- \* CLIA
- \* Rilibäk
- \* RCPA

3° State of the Art

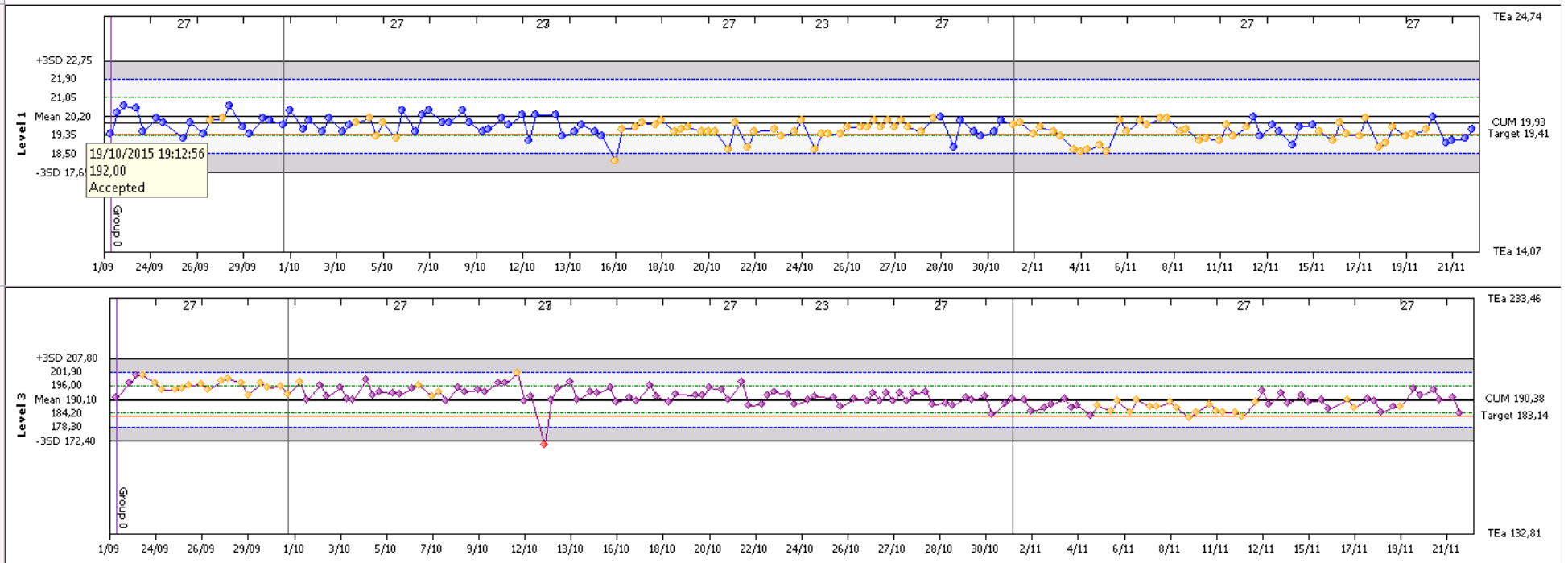
⇒ Westgard rules (fixed  $\mu$ )

⇒ Stopleimits (peer  $\pm$  TEa)

Visualised in unity real time (Biorad)

# 3. Chemistry lab: IQC (2)

▶ Levey-Jennings Chart Panel: Multiqual unassayed Period: 23/09/2015 - 22/11/2015  
 Lab: 829904, Sint-Andries Ziekenhuis, Laboratorium, Hilde Vandenbussche, Laboratorium  
 Lot: 46550, Multiqual 1,2,3 Unassayed, Serum, Bio-Rad Laboratories, 31/03/2017  
 ALT (ALAT/GPT), UV without PSP, Roche cobas 6000, Dedicated Reagent, U/L, 37° C  
 Cum Mean/SD/CV: [1] 19,93/0,70/3,53, [3] 190,38/3,89/2,04, Fixed Mean/SD/CV: [1] 20,20/0,85/4,21, [3] 190,10/5,90/3,10  
 Summary Stats for 23/09/2015 to 22/11/2015 Mean/SD/CV/Points: [1] 19,64/0,46/2,36/142, [3] 191,19/4,01/2,10/140  
 Graph against: Your laboratory, Current instrument, Evaluation Mean/SD  
 3. Controle opnieuw voor deze analyse  
 23. Wekelijks onderhoud  
 27. Nieuw reagenscassette zelfde lot

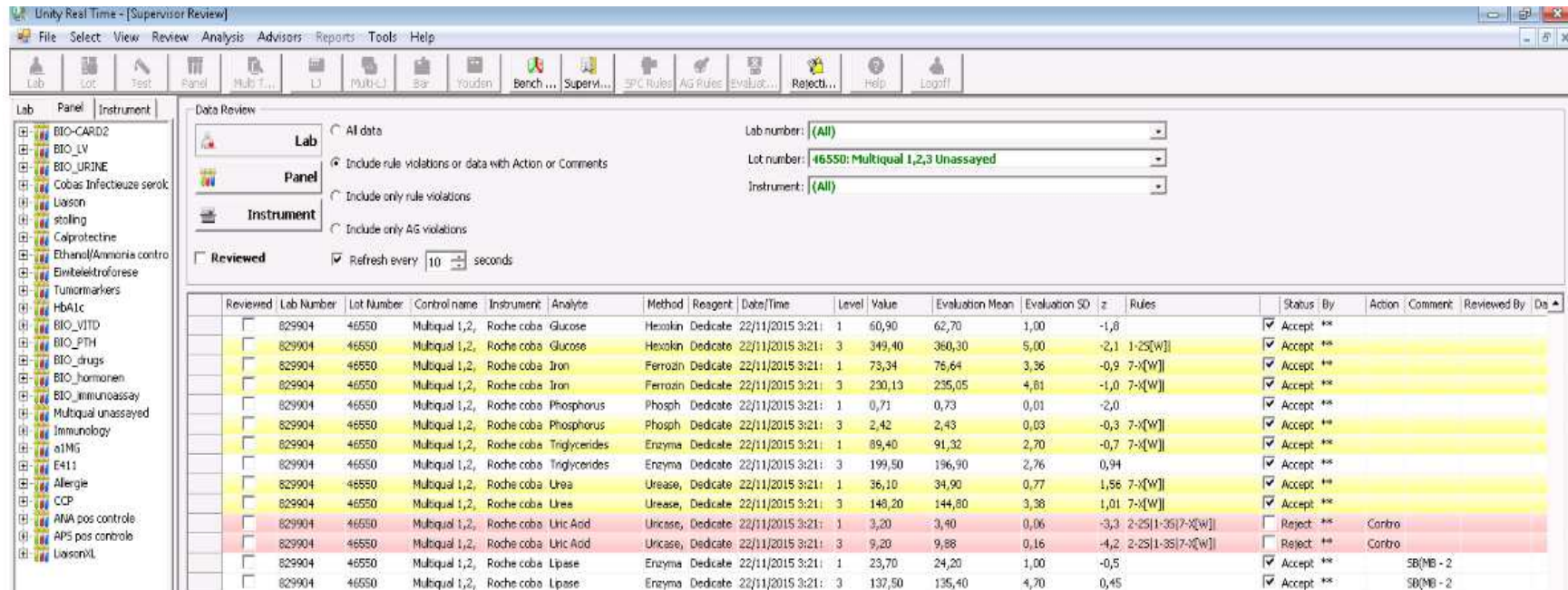


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## 3.1 Daily FU IQC (1)

1. Lab technician: bench review
2. Clinical biologist: supervisor review

-> logging actions & comments



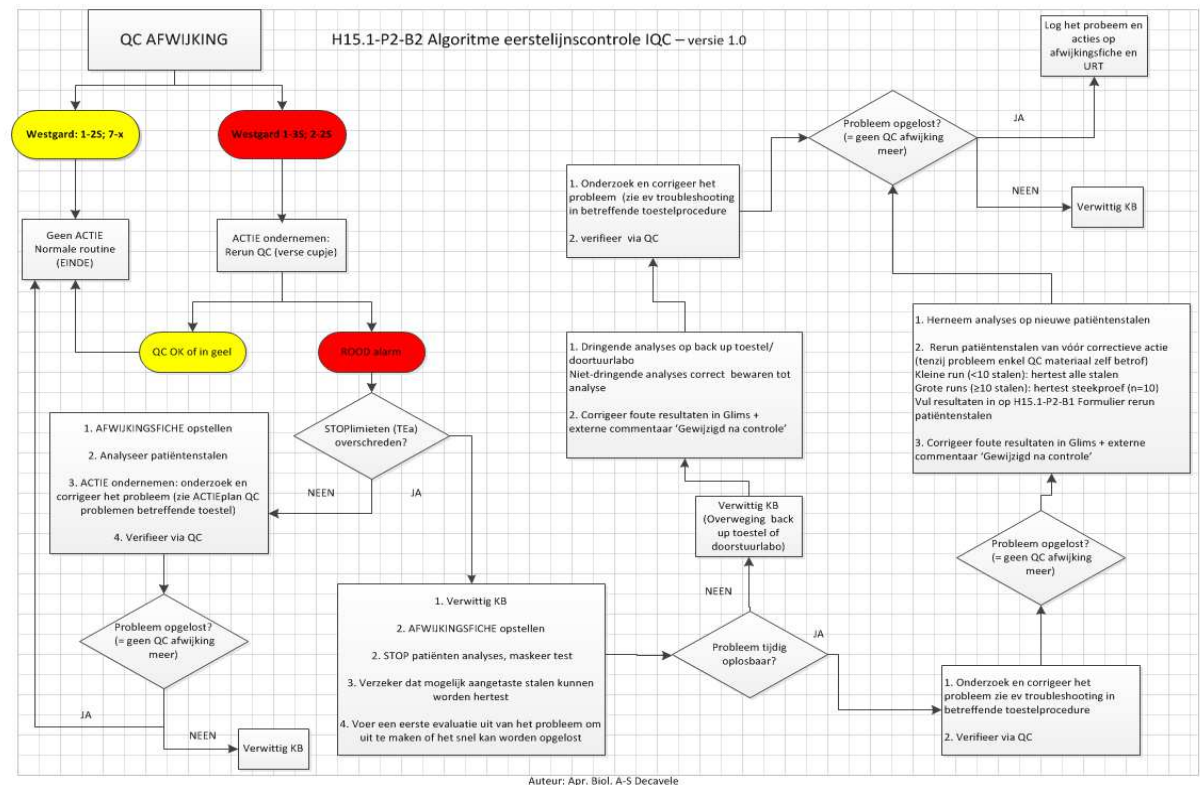
Reviewed	Lab Number	Lot Number	Control name	Instrument	Analyte	Method	Reagent	Date/Time	Level	Value	Evaluation Mean	Evaluation SD	z	Rules	Status	By	Action	Comment	Reviewed By
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Glucose	Hexokin	Dedicate	22/11/2015 3:21	1	60,90	62,70	1,00	-1,8		✓	Accept	**		
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Glucose	Hexokin	Dedicate	22/11/2015 3:21	3	349,40	360,30	5,00	-2,1	1-25[W]	✓	Accept	**		
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Iron	Ferrozin	Dedicate	22/11/2015 3:21	1	73,34	76,64	3,36	-0,9	7-[W]	✓	Accept	**		
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Iron	Ferrozin	Dedicate	22/11/2015 3:21	3	230,13	235,05	4,81	-1,0	7-[W]	✓	Accept	**		
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Phosphorus	Phosph	Dedicate	22/11/2015 3:21	1	0,71	0,73	0,01	-2,0		✓	Accept	**		
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Phosphorus	Phosph	Dedicate	22/11/2015 3:21	3	2,42	2,43	0,03	-0,3	7-[W]	✓	Accept	**		
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Triglycerides	Enzymia	Dedicate	22/11/2015 3:21	1	89,40	91,32	2,70	-0,7	7-[W]	✓	Accept	**		
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Triglycerides	Enzymia	Dedicate	22/11/2015 3:21	3	199,50	196,90	2,76	0,94		✓	Accept	**		
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Urea	Urease	Dedicate	22/11/2015 3:21	1	36,10	34,90	0,77	1,56	7-[W]	✓	Accept	**		
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Urea	Urease	Dedicate	22/11/2015 3:21	3	148,20	144,80	3,38	1,01	7-[W]	✓	Accept	**		
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Uric Acid	Uricase	Dedicate	22/11/2015 3:21	1	3,20	3,40	0,06	-3,3	2-25(1-35)(7-[W])	✗	Reject	**	Contro	
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Uric Acid	Uricase	Dedicate	22/11/2015 3:21	3	9,20	9,88	0,16	-4,2	2-25(1-35)(7-[W])	✗	Reject	**	Contro	
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Lipase	Enzymia	Dedicate	22/11/2015 3:21	1	23,70	24,20	1,00	-0,5		✓	Accept	**		SB(MB - 2)
<input type="checkbox"/>	829904	46550	Multiquel 1,2	Roche cobra	Lipase	Enzymia	Dedicate	22/11/2015 3:21	3	137,50	135,40	4,70	0,45		✓	Accept	**		SB(MB - 2)

# 3.1 Daily FU IQC (2)

## Procedures Algoritme 1st line interpretation IQC

Samengevat:

Alarm	QC regel	QC resultaat	Patiëntenresultaat
Geen (wit)	/	QC resultaat wordt automatisch geaccepteerd	OK
<b>GEEL</b> waarschuwing	1-2s  7-x	GEEN ACTIE; QC resultaat mag geaccepteerd worden  ENKEL ACTIE indien KB dit aangeeft, resultaat mag geaccepteerd worden	OK  OK
<b>ROOD</b> analytische fout	1-3s 2-2s	ACTIE en QC resultaat accepteren of verwerpen	OK
<b>GEEL</b> klinische fout	TEa overschreden	ACTIE en QC resultaat verwerpen	STOPLIMIET



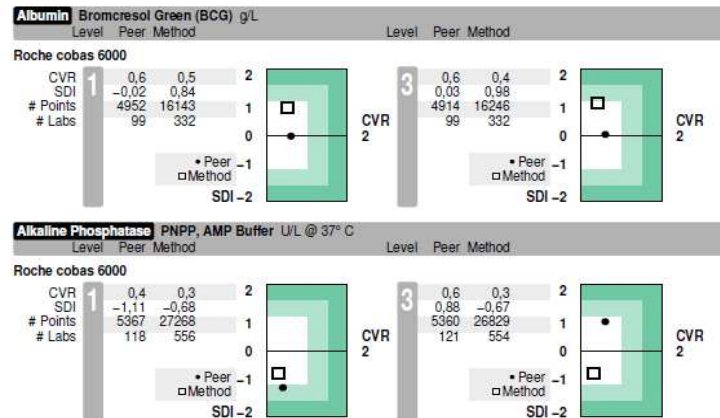
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# 3.2 Monthly FU IQC (1)

## My Unity reports

### Laboratory Performance Overview

Multiquel 1,2,3 Unassayed • Lot 46550 • Exp 31-Mar-2017



### Laboratory Comparison Report

Multiquel 1,2,3 Unassayed • Lot 46550 • Exp 31-Mar-2017

Krommewalstraat 11  
8700 Tielst West-Vlaanderen  
Attention: Hilde Vandebussche  
Laboratorium

Albumin Bromocresol Green (BCG) g/L	Level	Mon	Cum	Peer Group Mon	Peer Group Cum	Method Group Mon	Method Group Cum
Roche cobas 6000	1	0,6	0,7	25,84	26,19	25,86	25,77
• Peer CVR	1	0,5	0,6	0,540	0,669	0,878	0,903
□ Method CVR	1	-0,02	0,47	2,1	2,6	3,4	3,5
• Peer SDI	1	0,84	1,07	69	783	4952	61057
□ Method SDI	1			99	137	16143	188K
• Peer CVR	3	0,6	0,6	45,73	46,07	45,70	45,63
□ Method CVR	3	0,4	0,5	0,589	0,721	1,06	1,14
• Peer SDI	3	0,03	0,38	1,3	1,6	2,3	2,5
□ Method SDI	3	0,98	1,09	67	764	4914	62122
• Peer CVR	3			99	137	16246	190K
□ Method CVR	3			332	453	332	453

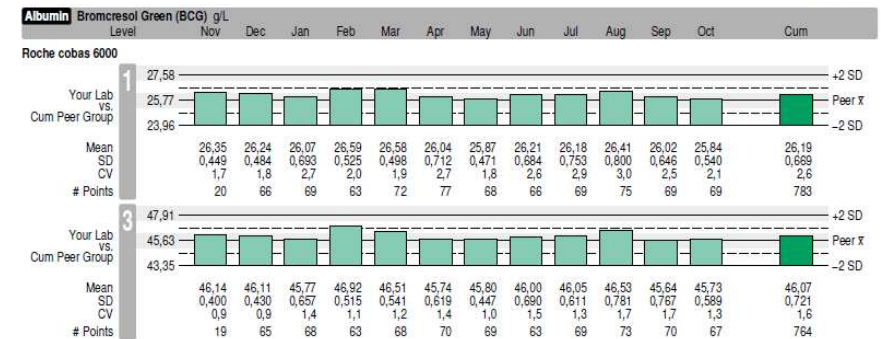


### Laboratory Histogram

Multiquel 1,2,3 Unassayed • Lot 46550 • Exp 31-Mar-2017

October 2015 • Lab 829904

Laboratorium  
Krommewalstraat 11  
8700 Tielst West-Vlaanderen  
Attention: Hilde Vandebussche  
Laboratorium

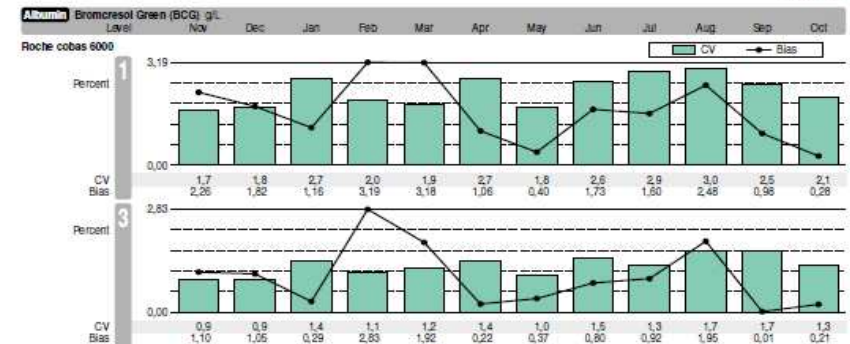


### Bias & Imprecision Histogram

Multiquel 1,2,3 Unassayed • Lot 46550 • Exp 31-Mar-2017

October 2015 • Lab 829904

Laboratorium  
Krommewalstraat 11  
8700 Tielst West-Vlaanderen  
Attention: Hilde Vandebussche  
Laboratorium





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## 3.4 Intermediate FU (1)

### 'Intermediate verification' of Cobas 6000

(closure lot QC or min. 2x/year)

- Checking performance characteristics (export QC data from URT)
  - > between run CV
  - > bias
  - > total error
- Evaluation against historical data (CV, bias, TE initial verification, criteria TEa en company (package insert)
- Checking EQC results
- Checking cost-benefit

	RF	CRP	IgA	IgG	IgM	a1-AT	Ferritine	ansferrin	C3	C4	ceruloplasmin	hapto
Gemiddelde aantal stalen	21	2438	87	51,5	45	11,8	560	556	7	6,8	8	12,8
kosten/baten	niet OK tov RIZIV wel tov doorstuur	OK	OK	net niet OK tov RIZIV, wel tov doorstuur	net niet OK tov RIZIV, wel tov doorstuur	niet OK	OK	OK	niet OK	niet OK	niet OK tov RIZIV wel tov doorstuur	niet OK tov RIZIV wel tov doorstuur
Imprecisie, between run CV (lot 66300)	OK	OK	OK	OK	OK	CV L1 opvolgen; L2 OK	OK	OK	OK	CV L1 opvolgen; L2 OK	CV L1 opvolgen; L2 OK	OK
Bias tov cum peer group	OK	OK	OK	OK	OK	OK	OK	OK	Bias L2 opvolgen (jan-feb te hoog); L1 OK	OK	OK	OK
Totale fout (%)	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
Maandelijkse verwerking Biorad (mei 2015)	OK	OK	OK	OK	OK	peer group n=2 nvt	OK	OK	OK	OK	OK	OK
kalibratiefrequentie	OK	OK	OK	OK	OK	max 12 weken zelfde cassette, wordt overschreden? Waardoor teveel reruns	OK	OK	OK; max 12 w met zelfde cassette, wordt langer gebruikt	OK; max 12 w met zelfde cassette, wordt langer gebruikt	Op tijd kalibreren, 3 maand geleden? Nakijken calibration trace	OK
							veel lotwissel			op zich geen probleem; want IQC OK	Cassette max 12 weken gebruiken, dit wordt niet	
EKE 2014/1	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
EKE 2014/2	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
EKE 2015/1	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
Besluit:	OK	OK	OK	OK	OK	Cassette te lang gebruikt? Kosten-baten niet OK -> doorsturen	lotreservatie 6 maand?	OK; grotere cassettes?	opvolgen bias; kalibratie? Te lang met zelfde cassette: > 12 weken waardoor ev overbodige reruns QC en kal; kosten-baten niet	? Te lang met zelfde cassette: > 12 weken waardoor ev overbodige reruns QC en kal; kosten-baten niet	Cassette max 12 weken gebruiken en op tijd kalibreren	OK

## 3.4 Intermediate FU (2)

### Example: conclusion 'intermediate verification' e601

1	VALIDATIERAPPORT COBAS-R2 tussentijdse validatie e601		
2	BESPREKING		
3			
4	Samenvatting zie apart tabblad, in deze bespreking worden de besluiten herhaald.		
5	LH	OK	
6	TSH	OK	
7	FT3	lot 40290: Opletten maandelijkse CV en bias level 1!! Kalibratiefrequentie batch test opvolgen	
8	FT4	2-maandelijks nieuw lot, niet mogelijk lotreservatie voor 6 maand?	
9	Vit B12	OK	
10	AFP	Waarom wordt zoveel gekalibreerd?	
11	CEA	OK	
12	Oestradiol E2, 3e gen	Kalibratiefrequentie opdrijven? Opvolgen nieuw lot reagens. Aliquotjes kalibrator slechts 1 maand gebruiken! Cfr mail Martijn Stax 15/07/15	andere testen? nakijken probleemgevallen: PSA, testo, tumormarkers, PROG!!
13	HCG	OK	
14	PROG	CV level 1 niet OK, voorlopige programmatie kalibratiefrequentie Cobas aanhouden en opvolgen	
15	FSH	OK	
16	PROL	OK	
17	PSA	maand kal OK, als cassette bijna op/bijna vervallen? Duidelijk daling in IQC en kalibratiefrequentie stijgt: op tijd cassette wisselen als IQC / kal niet OK	
18	CORT	er wordt niet altijd maandelijks gekal (=batch), dus QC steeds OK	
19	FZ	OK	
20	TropThs	Opmerking gekozen IQC: er is IQC met betere target op de markt, werd gevalideerd maar is te duur. En niet mogelijk om per level aan te kopen. Zie map IQC	
21	PTH	OK	
		Frequenter kalibreren (CV L1 te hoog, TF>TEa)? Bij nazicht calibration trace blijkt SAT niet maandelijks te kalibreren; rack pack op 28 zetten, kosten-baten: ruimte voor maandelijkse kalibratie, gezien 3 maand met 1 kit en tasten nog niet op	
22	TESTO		
23	CA125	Maandelijks kalibratie geprogrammeerd op Cobas? Voorlopig afwachten, adhv IQC.	
24	CA15.3	Maandelijks kalibratie te programmeren op Cobas	
25	CA19.9	Maandelijks kalibratie geprogrammeerd op Cobas? Te doen!	
26			
27	BESLUIT		
28			
29	De prestatie van de batchtesten dient goed opgevolgd te worden; daar deze cassettes soms tot 3 maand worden gebruikt en de stabiliteit achteruit gaat.		
30	Men moet op tijd kalibreren of cassette vervangen. Waar mogelijk, wordt de programmatie van de kalibratie aangepast thv toestel.		

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## 4. Patient percentile monitoring

Analiët	Kwaliteit	Opmerking
Albumine	😊	Hogere populatievariatie, maar schijnbaar goeie stabiliteit
ALP	😊-😬	Lange termijn opwaartse drift (gedurende 2015) borderline op de limieten
ALT	😊	Goeie stabiliteit
AST	😊-😬	Goeie stabiliteit (borderline binnen de limieten); iets lagere waarden op het einde van de observatietijd
Calcium	😊-😬	Shift in augustus 2014 borderline op de limieten
Chloride	😊	Goeie stabiliteit (borderline binnen de limieten)
Creatinine	😬	Shift in Okt – Nov 2014 mogelijks te wijten aan softwarewijziging; daarna verhoogde instabiliteit
CRP	/	Moeilijke interpretatie door hoge populatievariatie
GGT	😊-😬	Moelijkere interpretatie door hogere populatievariatie; mogelijks ook beïnvloed door softwarewijziging
Glucose	😊	Goeie stabiliteit (borderline binnen de limieten)
Fosfaat	😊	Goeie stabiliteit (borderline binnen de limieten)
LDH	😊	Goeie stabiliteit
Magnesium	😊	Goeie stabiliteit
Kalium	😊	Shift in Okt – Nov 2014 mogelijks te wijten aan softwarewijziging
Natrium	😊	Goeie stabiliteit
totaal-Bilirubine	😊	Goeie stabiliteit
totaal-Cholesterol	😊	Goeie stabiliteit
totaal-Eiwit	😬	Borderline buiten de limieten; de stabiliteit van deze assay heeft nood aan verbetering
Ureum	😊	Goeie stabiliteit (borderline binnen de limieten)

# 4. Patient percentile monitoring

Please review your QC reports for October 2015.

! The tests listed below may require investigation or review !

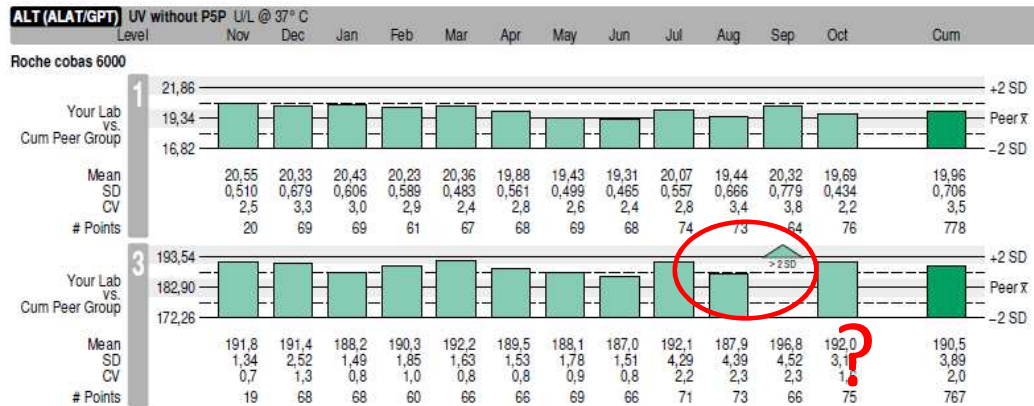
ALT (ALAT/GPT)	UV without P5P	U/L @ 37° C	Level	Lab	Peer	Method
<b>Roche cobas 6000</b>						
Peer CVR	1	0,3	This level is within established parameters			
Method CVR		0,2				
Peer SDI		0,61				
Method SDI		-0,18				
Mean	1	19,69	18,92	20,21		
SD		0,434	1,26	2,96		
CV		2,2	6,7	14,7		
# Points		76	7113	24481		
# Labs			147	486		
Mean	3	192,0	181,7	179,7		
SD		3,13	5,06	11,35		
CV		1,6	2,8	6,3		
# Points		75	7073	24049		
# Labs			148	482		

## Case 1 : ALT Monthly evaluation unity reports

**Unity** Laboratory Histogram  
Multiqual 1,2,3 Unassayed • Lot 46550 • Exp 31-Mar-2017

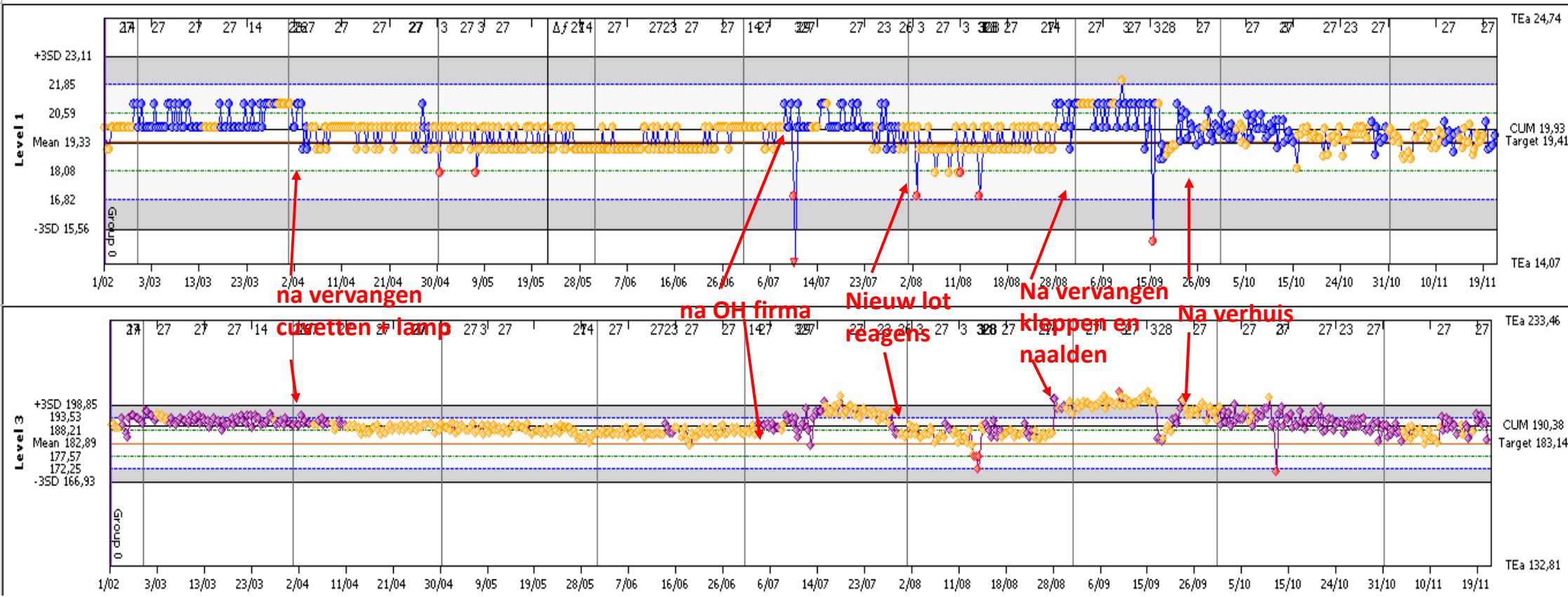
October 2015 • Lab 829904

Laboratorium



-> IQC Levey Jennings?

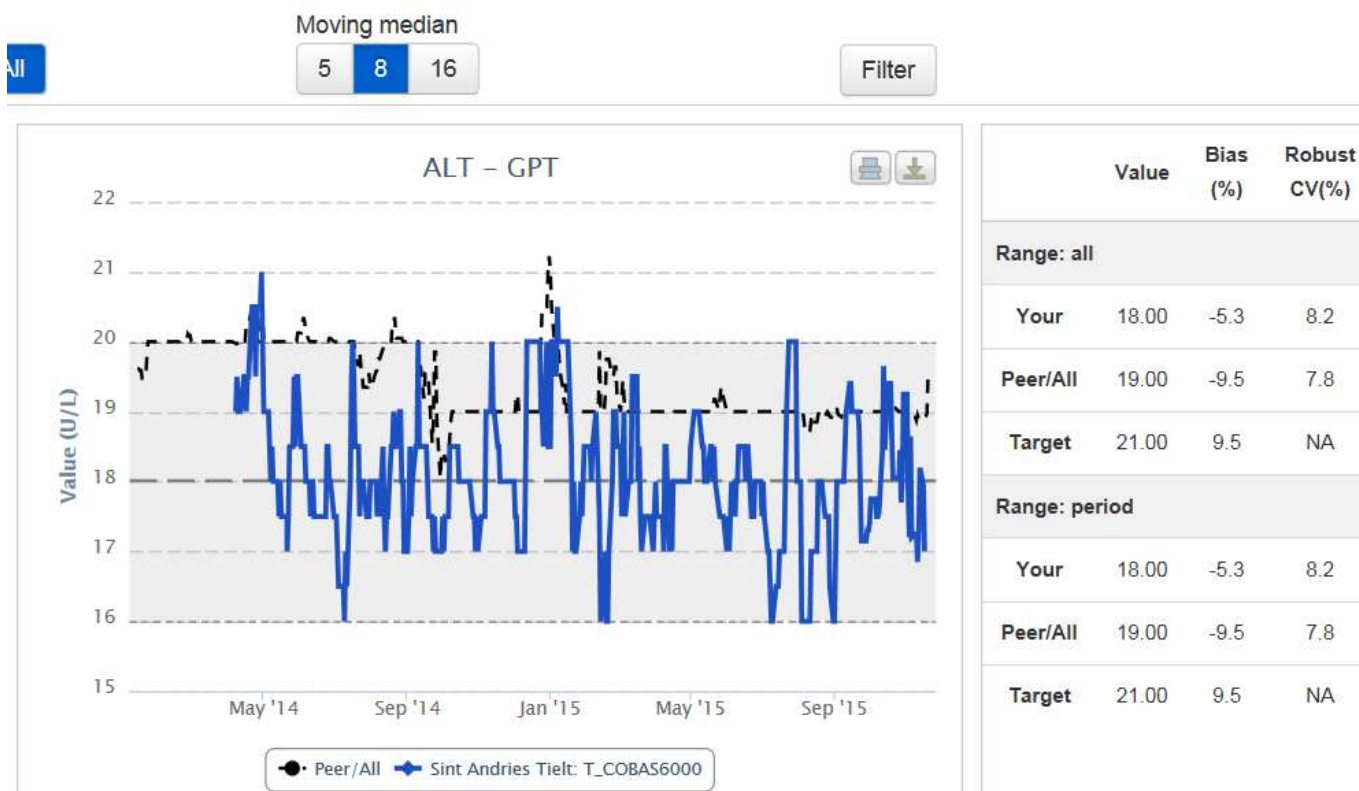
# 4. Patient percentile monitoring



Analytical variability-> within TEa limits, no significant influence on patient results?

# 4. Patient percentile monitoring

ALT



Confirmation ?

Moving median n=8  
Good stability

Analytical variability  
within stability limits,  
09-10/15  
(bias Empower 11%)



# 4. Patient percentile monitoring

ALT

Confirmation with PPM,  
Moving median n=5

Violation stability limits  
not > 1week?

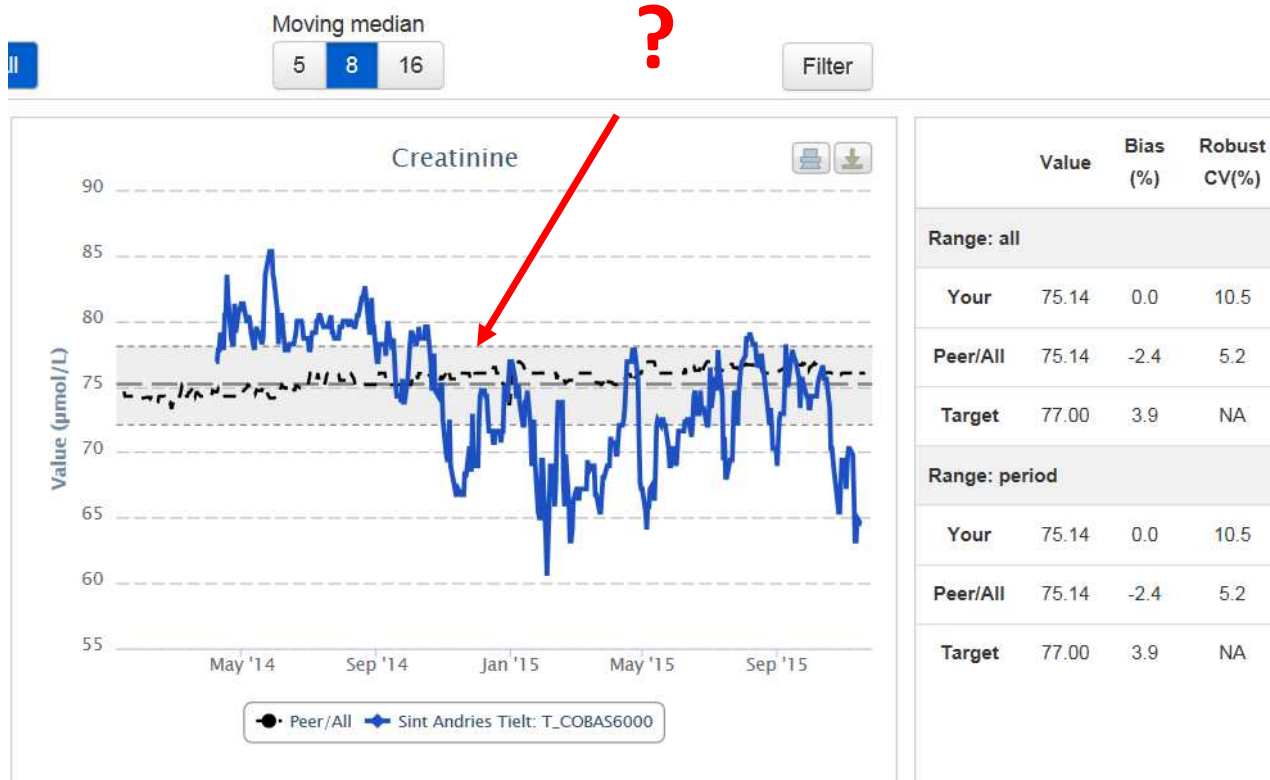
What to choose n=5, n=8?  
Risk of over/under-  
interpreting?

-> exclusively monitoring mid  
to long term stability  
-> small laboratory: high n



# 4. Patient percentile monitoring

## Case 2: Creatinine



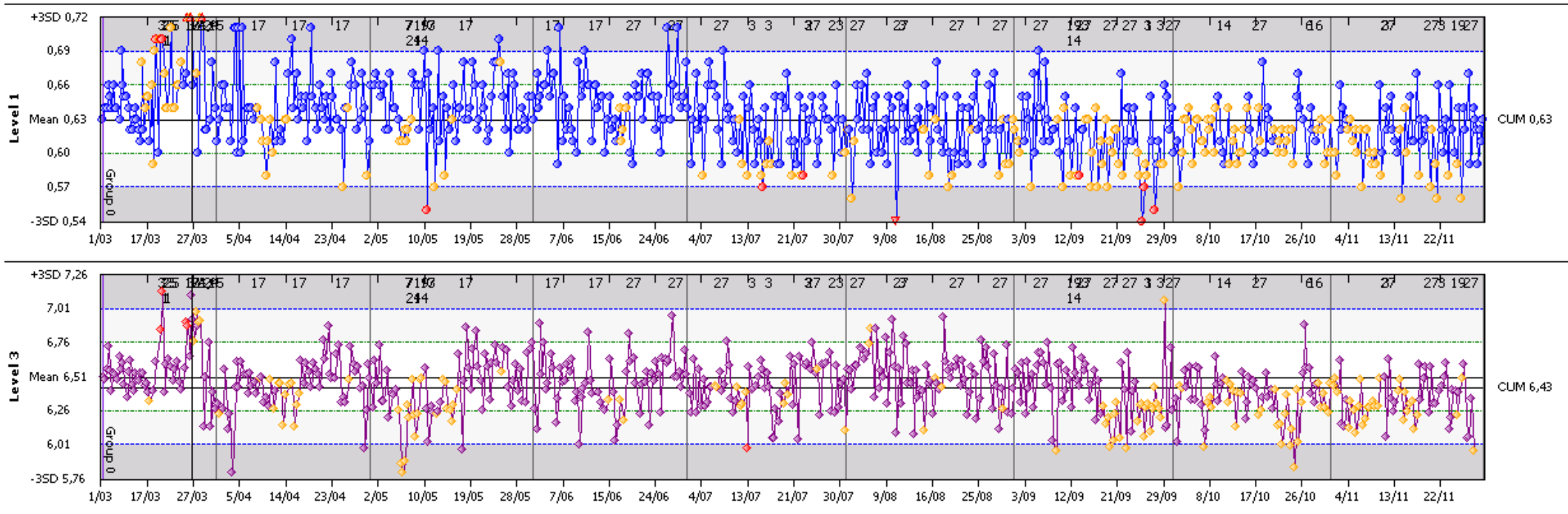
Shift octobre –  
novembre 2014?

# 4. Patient percentile monitoring

Creatinine

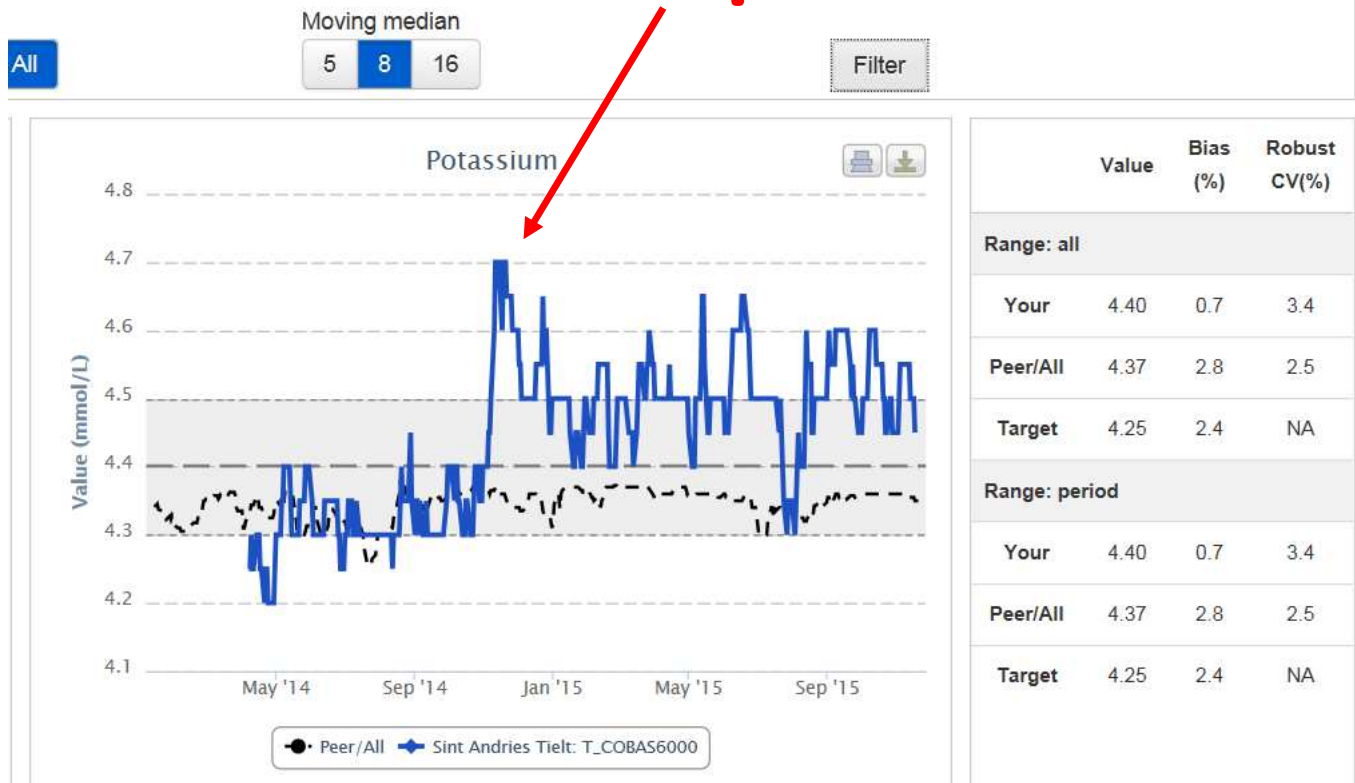
IQC stable

EQC OK; monthly reports peer group Biorad OK



# 4. Patient percentile monitoring

## Case 3: Potassium



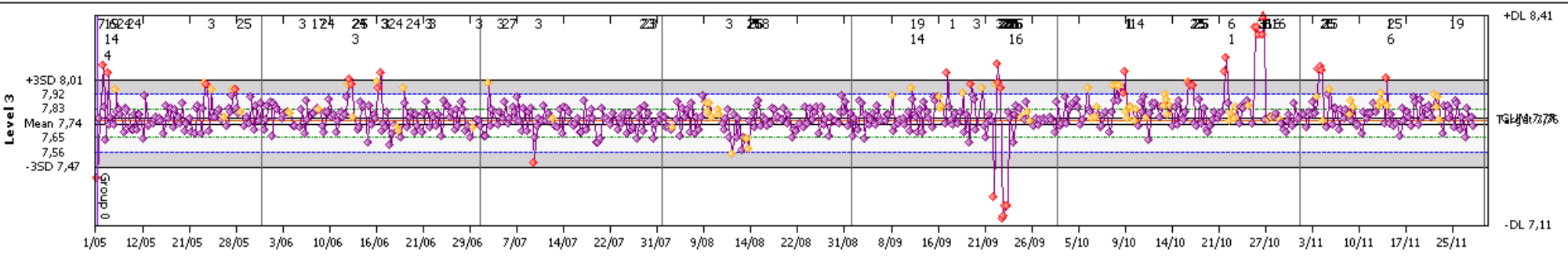
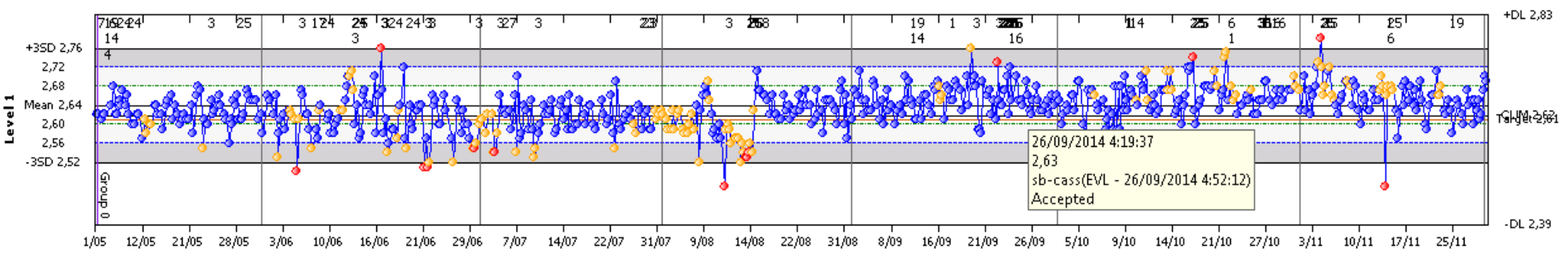
Shift octobre –  
novembre 2014?

# 4. Patient percentile monitoring

Potassium

IQC stable

EQC OK; monthly reports peer group Biorad OK



## 4. Patient percentile monitoring

Shift creatinine and potassium, same period : reason?

End of octobre 2014: new hospital information system (OAZIS)

-> change in registration patients?

Less patients are registrated as ambulant (higher population variation)

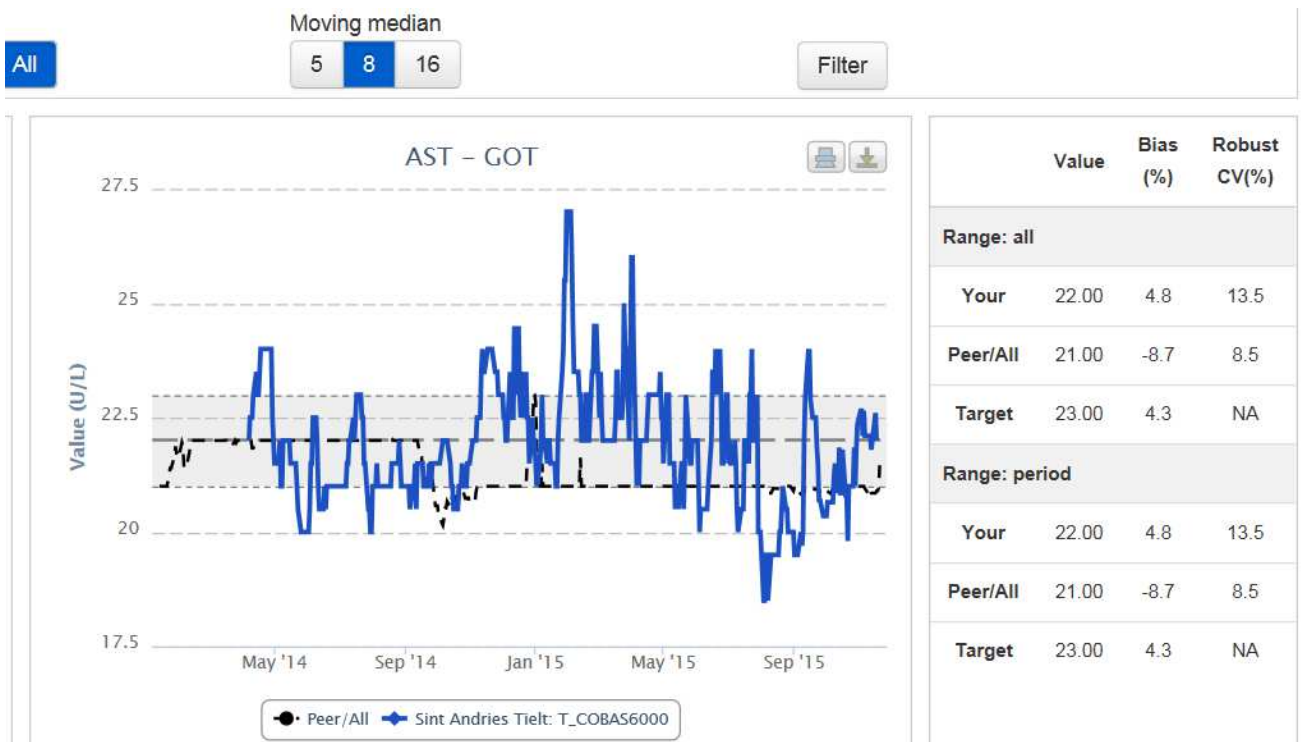
Reason? Asked ICT : still no answer

-> **Population variation**

-> **Assay is stable**

# 4. Patient percentile monitoring

## Case 4: AST



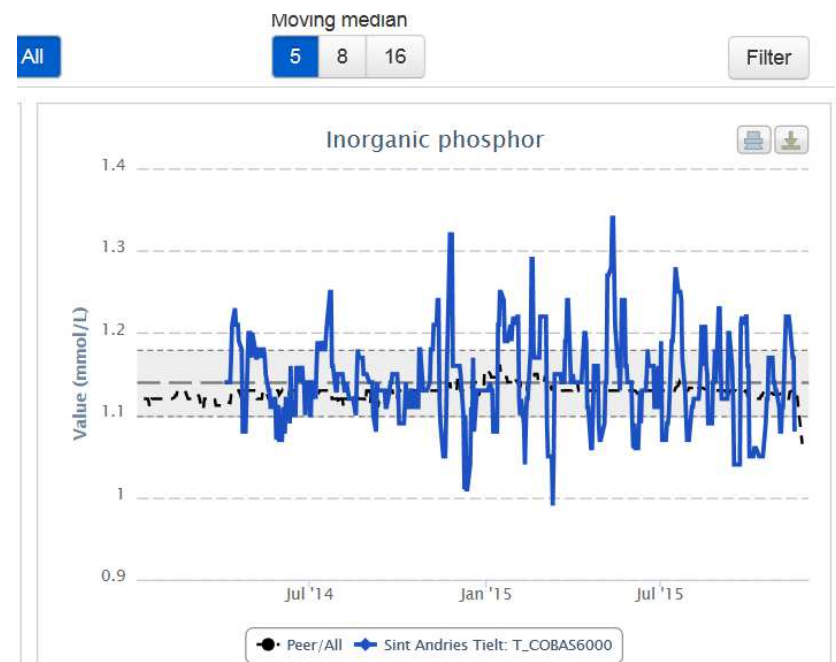
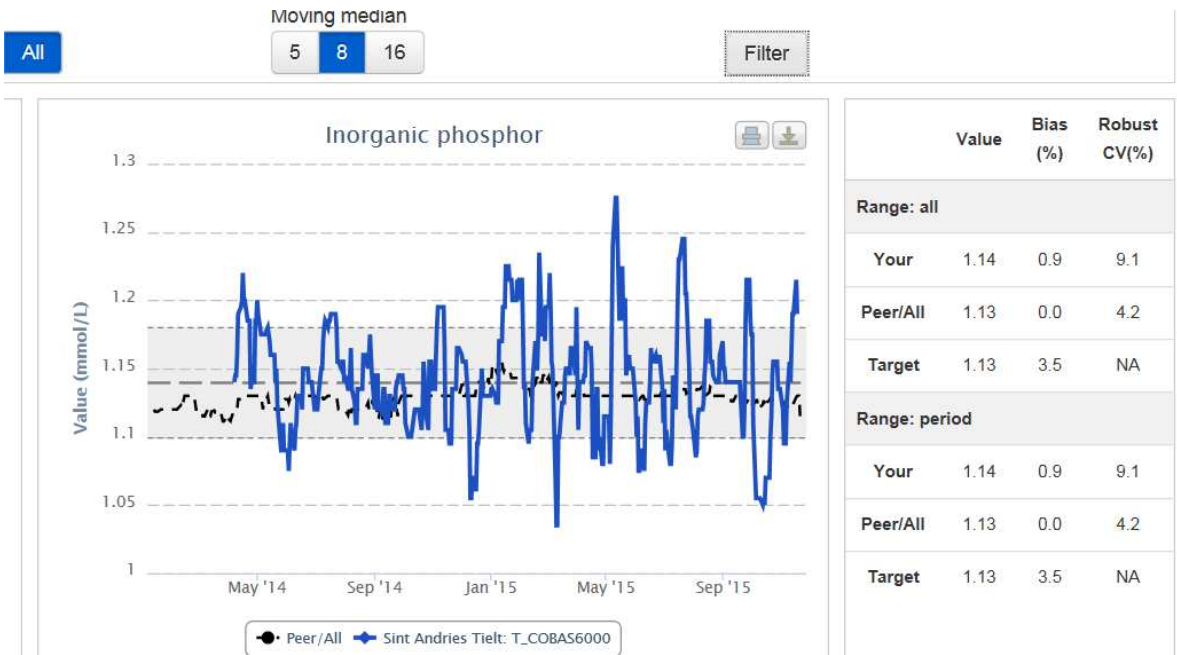
Stability OK ?  
(borderline within limits)

# 4. Patient percentile monitoring

## Case 5: inorganic phosphor

High population variation

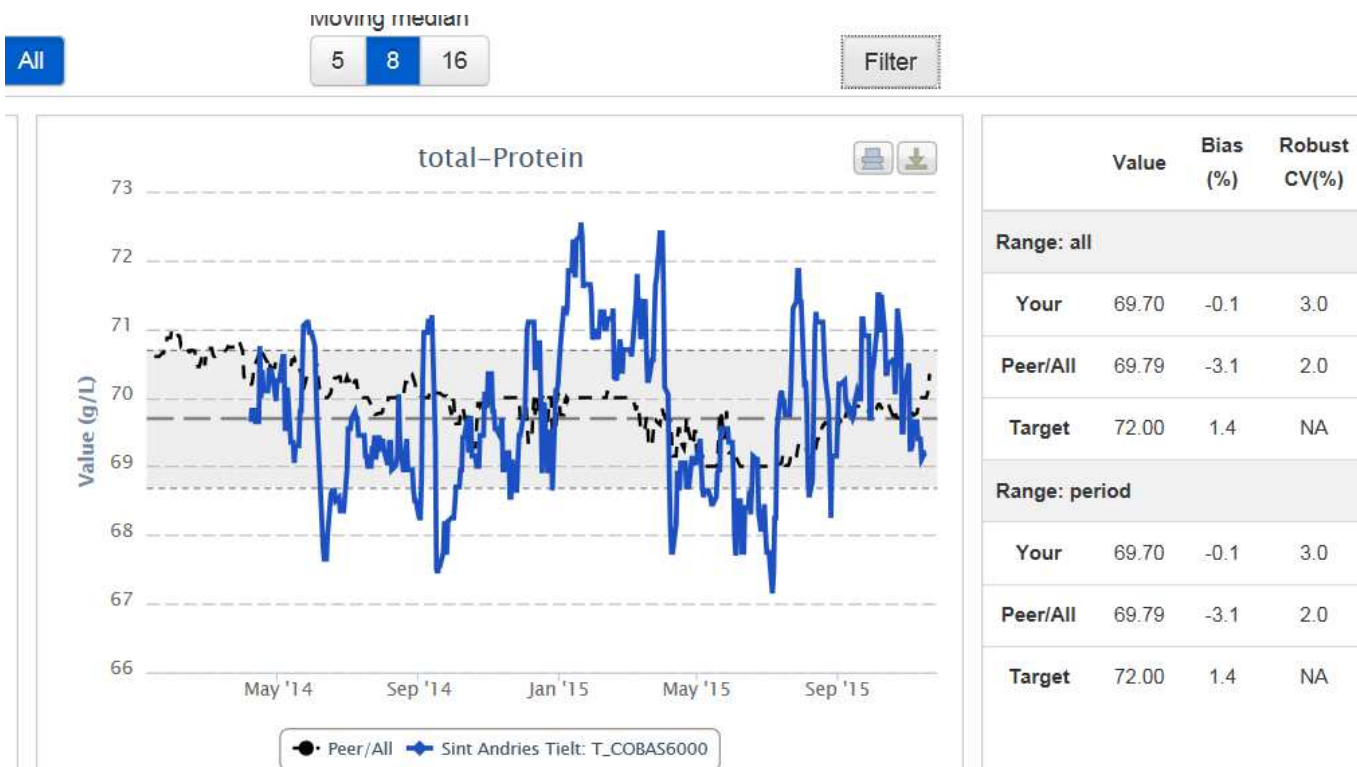
-> stability test OK





# 4. Patient percentile monitoring

## Case 6: TP



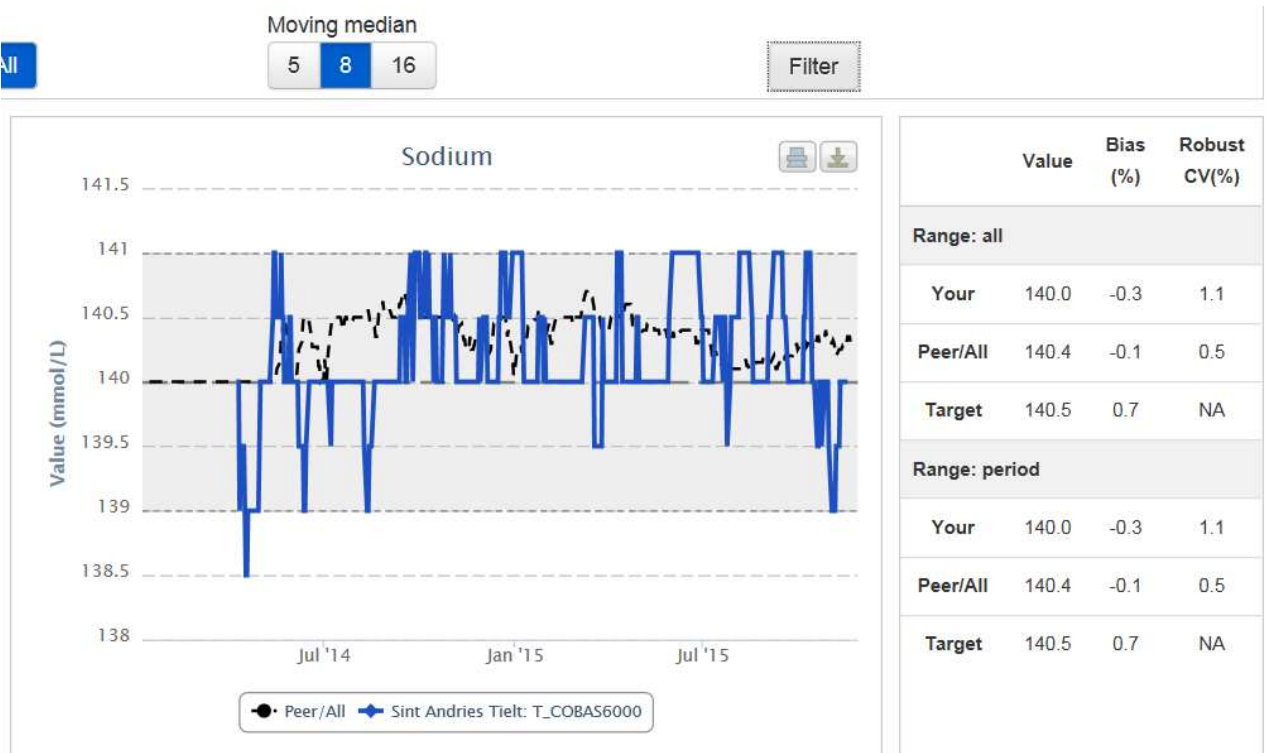
Violation of stability limits due to measurement method.

Same pattern seen in all laboratories .

-> Need for improvement measurement method

# 4. Patient percentile monitoring

## Case 7 : sodium



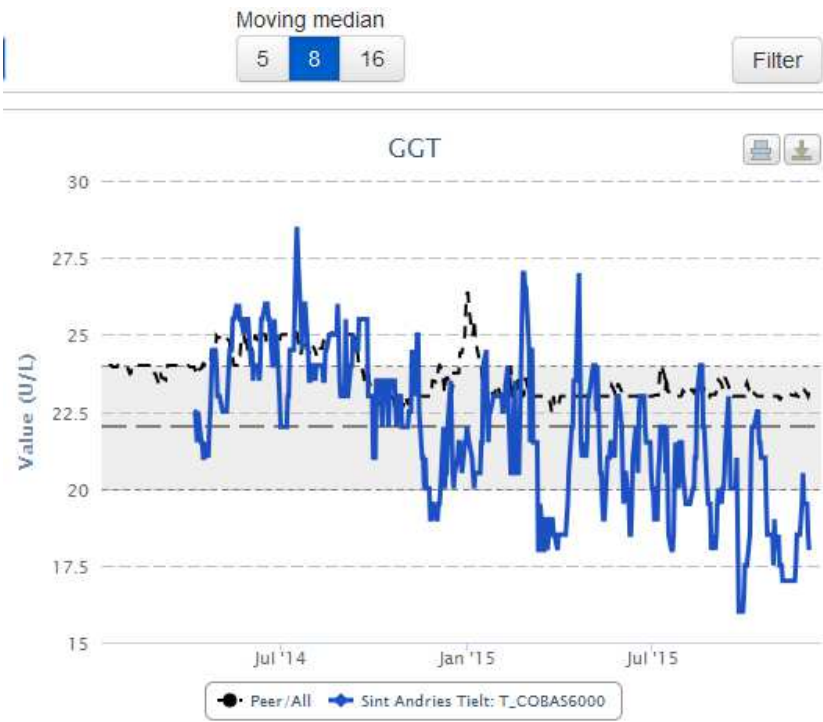
Good stability

Good comparison with peer group

# 4. Patient percentile monitoring

Case 8 : GGT

Population variation?  
Assay stability?

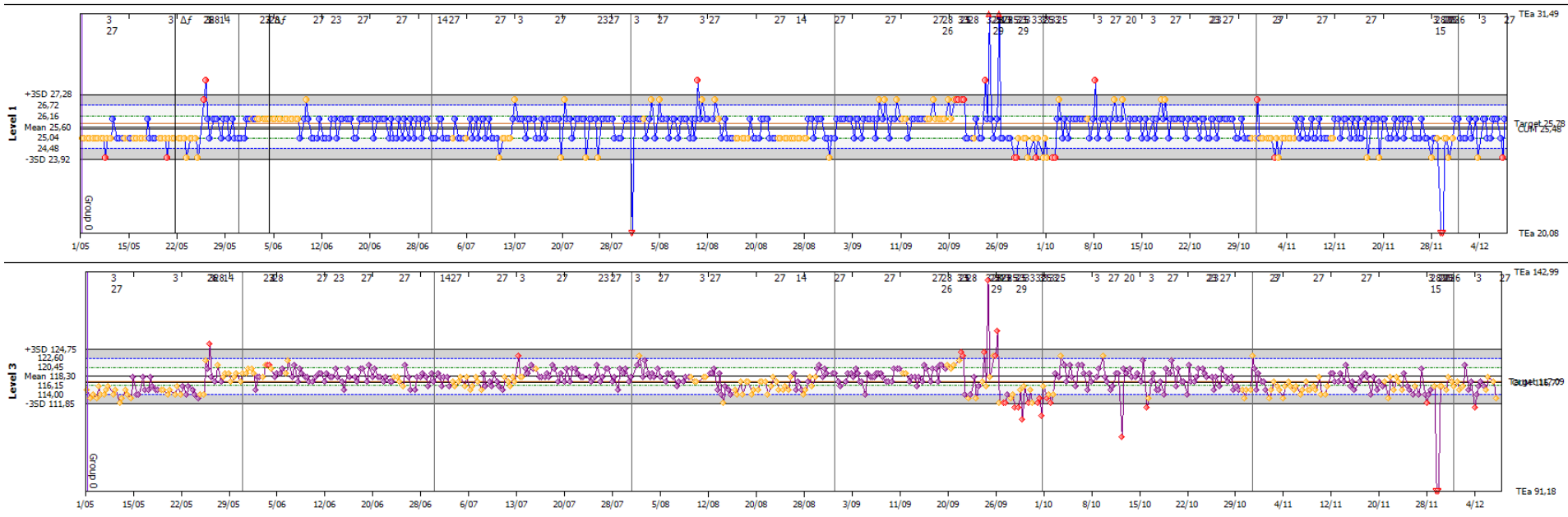


	Value	Bias (%)	Robust CV(%)
<b>Range: all</b>			
Your	22.00	-2.8	20.2
Peer/All	22.63	2.9	10.8
Target	22.00	9.1	NA
<b>Range: period</b>			
Your	22.00	-2.8	20.2
Peer/All	22.63	2.9	10.8
Target	22.00	9.1	NA



# 4. Patient percentile monitoring

Case 8 : GGT  
 IQC +/- stable



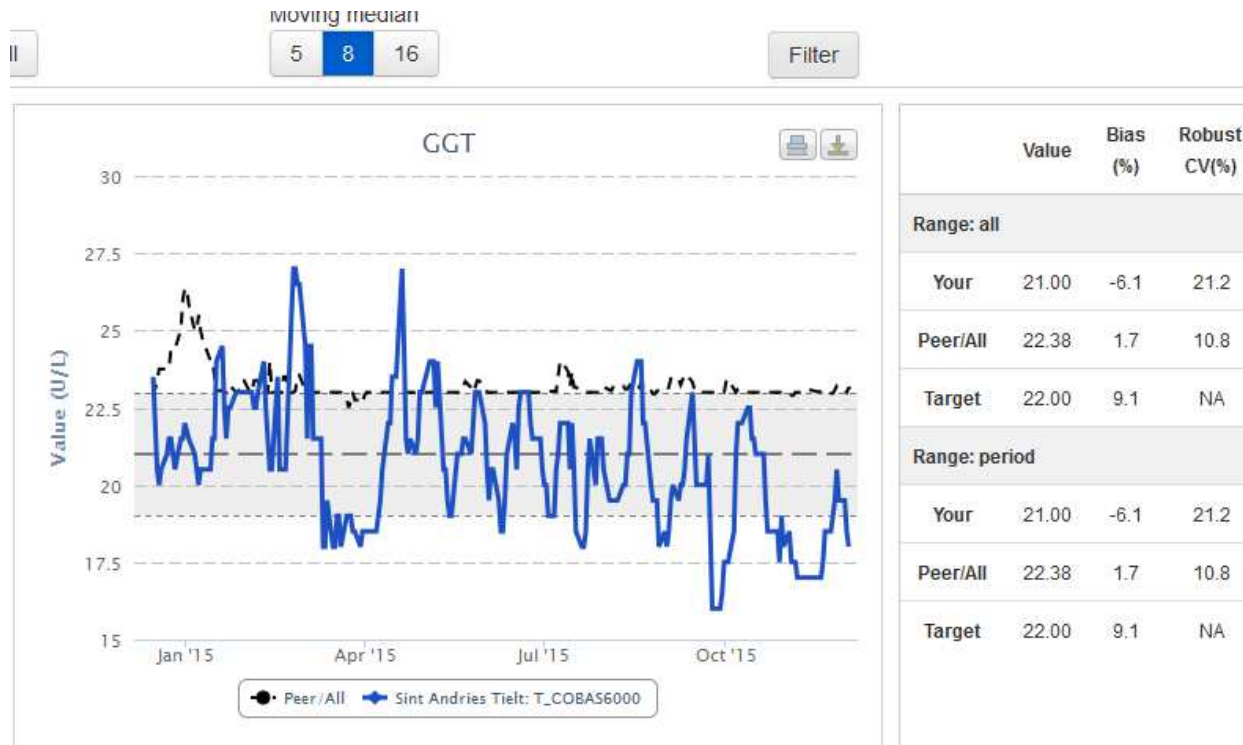
# 4. Patient percentile monitoring

Case 8 : GGT

Nov 14: change HIS

11/1/15 – 26/5/15- 18/9/15 -29/11/15: reagent lot change

-> +/- within limits



1. Introduction: Hospital Sint Andries – Clinical laboratory
2. Chemistry lab: QC
3. Chemistry lab: IQC
  - 3.1 Daily FU IQC
  - 3.2 Monthly FU IQC
  - 3.4 Intermediate FU
4. Patient percentile monitoring
5. Conclusions

## 5. Conclusions



- Patientsamples: following pre- to postanalytic phase
- Exclusion of controlmaterial related variables: matrix-effect, unfreezing time QC material, mixing up by technician
- No extra cost
- Reflection of influence on patient data of trends and shifts due to reagent lot changes
- Mid- to long-term follow up analytical stability
- Comparison of results and stability among laboratories (peer) and manufacturers



- Calculation patient medians on how many data? Indication of number measured tests of analyte
- Peer group: instrument type (Cobas 6000 vs 8000) and method principle (ex. creatinin)
- Small laboratory: high population variation, difficult interpretation of results: population variation or assay instability

# Questions?

