POCT in diagnosing and monitoring of Diabetes Mellitus

13th EFLM Continuous Postgraduate Course,
Sverre Sandberg,
Noklus / EFLM

The most important constituents

- Glucose – monitoring and diagnosing
- U-albumin – monitoring and diagnosing “microalbuminuria”
- HbA1c – monitoring and diagnosing

So

– the main question is: Can we use POCT for monitoring and/or diagnosing diabetes mellitus.

- And if yes – what are the presuppositions for doing it.

Monitoring

The test result is compared with previous test result(s) and differences between test results are compared to a change in the clinical condition.

When the level has been established, reproducibility is of most importance

Information about within-subject variation and analytical variation is important.

Monitoring accuracy studies are important

Monitoring: Critical difference

The differences between the two results given is the medical critical difference (CD) that should be detected by the actual measurement method.

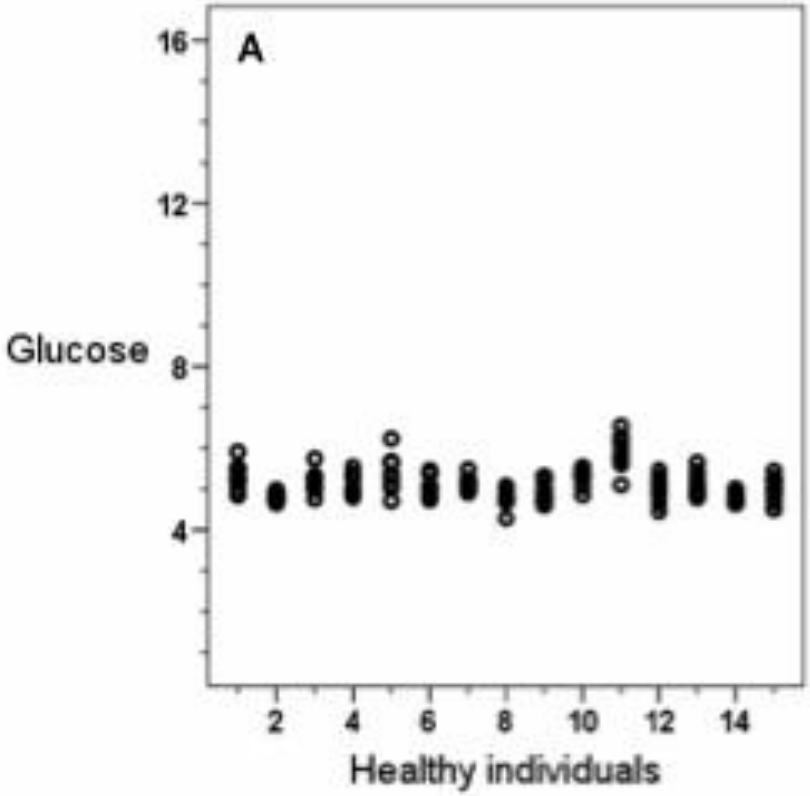
<u>The CD can comprise:</u>

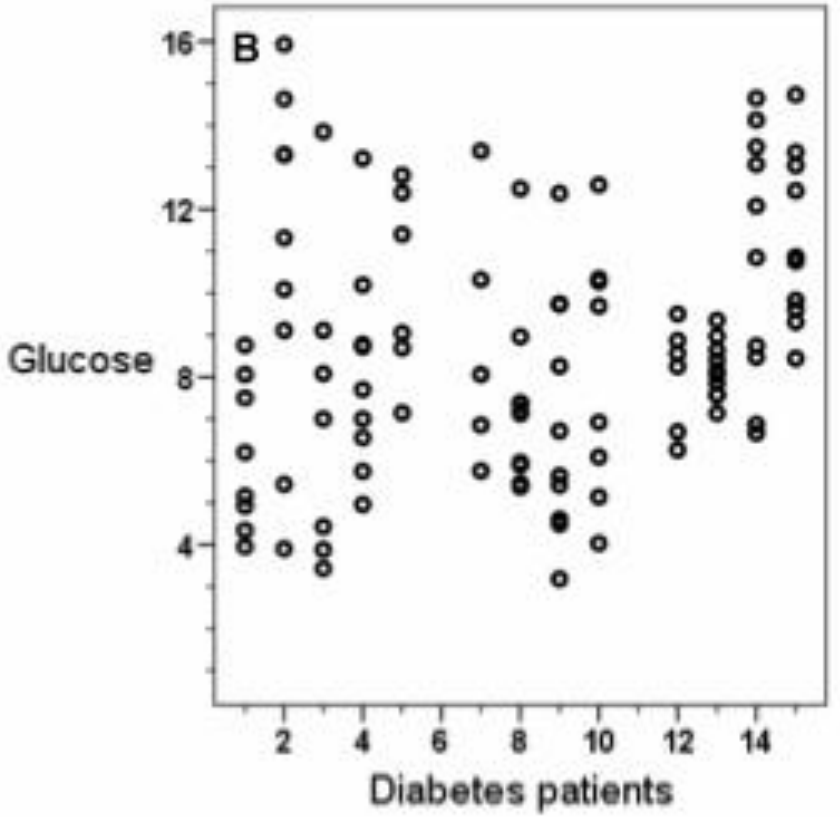
- pre-analytical variation
- imprecision under defined reproducibility conditions
- within-subject variation
- bias

Monitoring:
Difference between two results
Calculations of CD or RCV

$$CD = bias + z \times \sqrt{2} \times \sqrt{CV_{ws}^2 + CV_a^2}$$

Glucose in healthy and in persons with diabetes





Within-subject variation - glucose

Table 1 Between-subject, within-subject and analytical coefficients of variation of ve… and diabetes patients (95% CI).

	Number of persons/ samples	Glucose, mmol/L Grand mean	CVbs, %	CVws, %	
Venous serum glucose					
Healthy individuals	15/148	5.1 (5.1–5.2)	5.6 (3.9–…	5.4 (4.7–6.0)	1.6)
Diabetes patients	13/108	8.6 (8.3–9.1)	16.8 (8.2–…	30.5 (26.7–35.5)	1.0)
Capillary plasma glucose					
Healthy individuals	15/148	5.5 (5.4–5.5)	5.8 (4.1–…	4.5 (3.9–5.1)	1.6)
Diabetes patients	13/108	8.6 (8.2–9.0)	16.3 (7.4–…	31.1 (27.3–36.3)	1.0)

Carlsen S et al . Clin. Chem. Lab. Med.2011;49:1501–7.

Monitoring of glucose

Instruments for self-monitoring of glucose have improved considerably the last 10 years.

No evidence that patients with DM not treated with insulin has any benefit of self-monitoring

A big industry

Evaluation of glucometers can be found on "skup.nu"

SKUP

Scandinavian evaluation of laboratory equipment for primary health care

SKandinavisk Udprøvning af laboratorieudstyr til Primærsektoren
SKandinavisk Utprøving av laboratorieutstyr for Primærhelsetjenesten
SKandinavisk Utpröving av laboratorieutrustning för Primärvården

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The three latest reports

Cobas h 232 POC system
Eurolyser smart 700/340 CRP
Accu-Chek Mobile

Show all

Choose component: Glucose

Summaries and Reports

Evaluation #	Instrument/testkit	Summary	Report
SKUP/2013/99*	Accu-Chek Mobile		Download PDF
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SKUP/2013/85	Nova StatStrip		Download PDF
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SKUP/2011/93*	Accu-Chek Performa		Download PDF
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POC Instrument evaluation

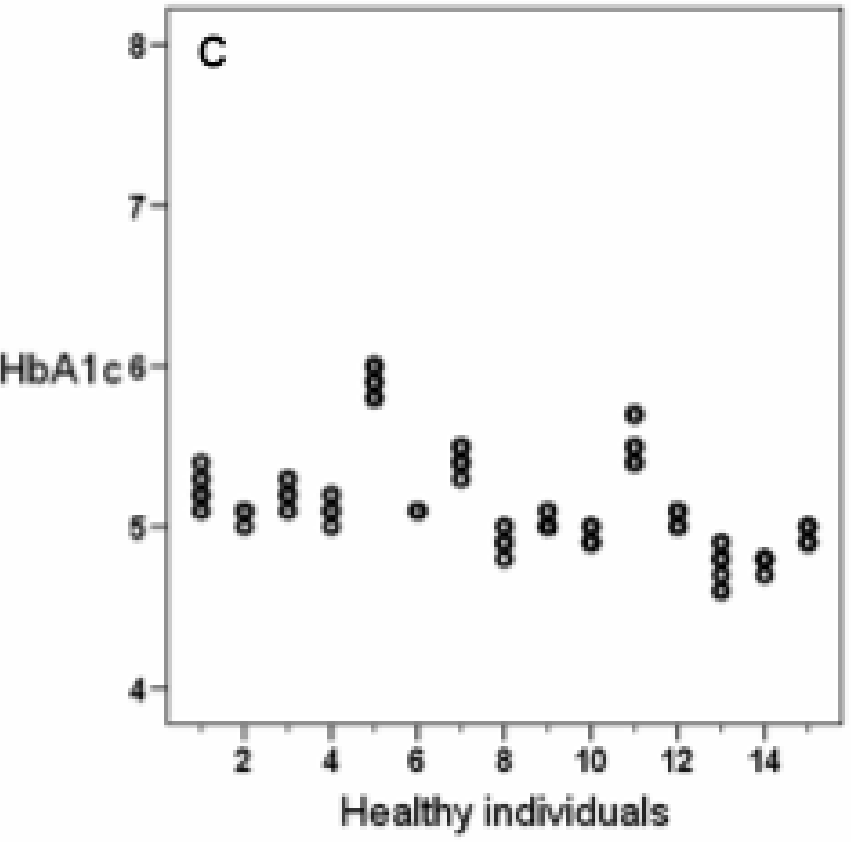
"What is missing in the EU is an independent institution that performs regular and critical evaluation of the quality of devices used for diabetes therapy before and also after their market approval."

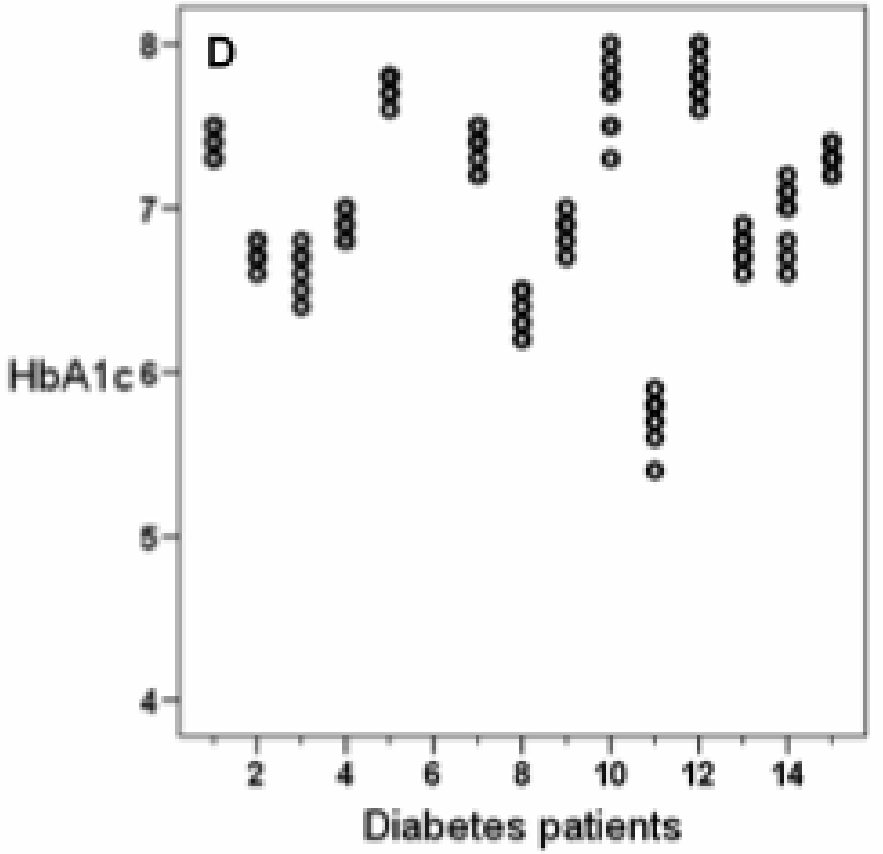
EASD Press Release
March 14, 2013
Avoiding a medical device disaster in diabetes

The European Association of Diabetes (EASD) today announces its intention to lobby for an urgent overhaul of medical device regulation in Europe to make it fit for purpose. "We want to avoid disasters similar to those that occurred with PIP breast implants and metal-on-metal hip replacements," says Professor Andrew Boulton, President of EASD, Professor of Medicine at the Universities of Manchester (UK) and Miami (FL, USA), and Consultant Physician at Manchester Royal Infirmary, UK.

EASD wants the European Union to follow the example of some Scandinavian countries in setting standards for medical devices. SKUP—The Scandinavian Evaluation of Laboratory Equipment for Primary Care (which covers Norway, Sweden and Denmark)—conducts rigorous trials of devices to ensure that they are easy to use and do what they are supposed to do safely.

HbA1c in heathy and in persons with diabetes





HbA1c

Table 2 Between-subject, within-subject and analytical coefficients of variation of HbA_{1c} in healthy individuals and diabetes patients (95% CI).

	Number of person/ samples	HbA_{1c}, %/mmol/mol Grand mean	CVbs, %	CVws, %	CVa, %
HbA_{1c}					
Healthy individuals	15/148	5.1 (5.0–5.2)/32.0 (31.0–33.			-0.6)
Diabetes patients	14/135	7.0 (6.9–7.1)/53.0 (52.0–54.			-0.6)

HbA_{1c} is reported in NGSP HbA_{1c} (%)/IFCC HbA_{1c} (mmol/mol).

CVws for healthy 1.2
CVws for patients 1.7

Carlsen S et al Clin Chem Lab Med. 2011;49:1501-7.

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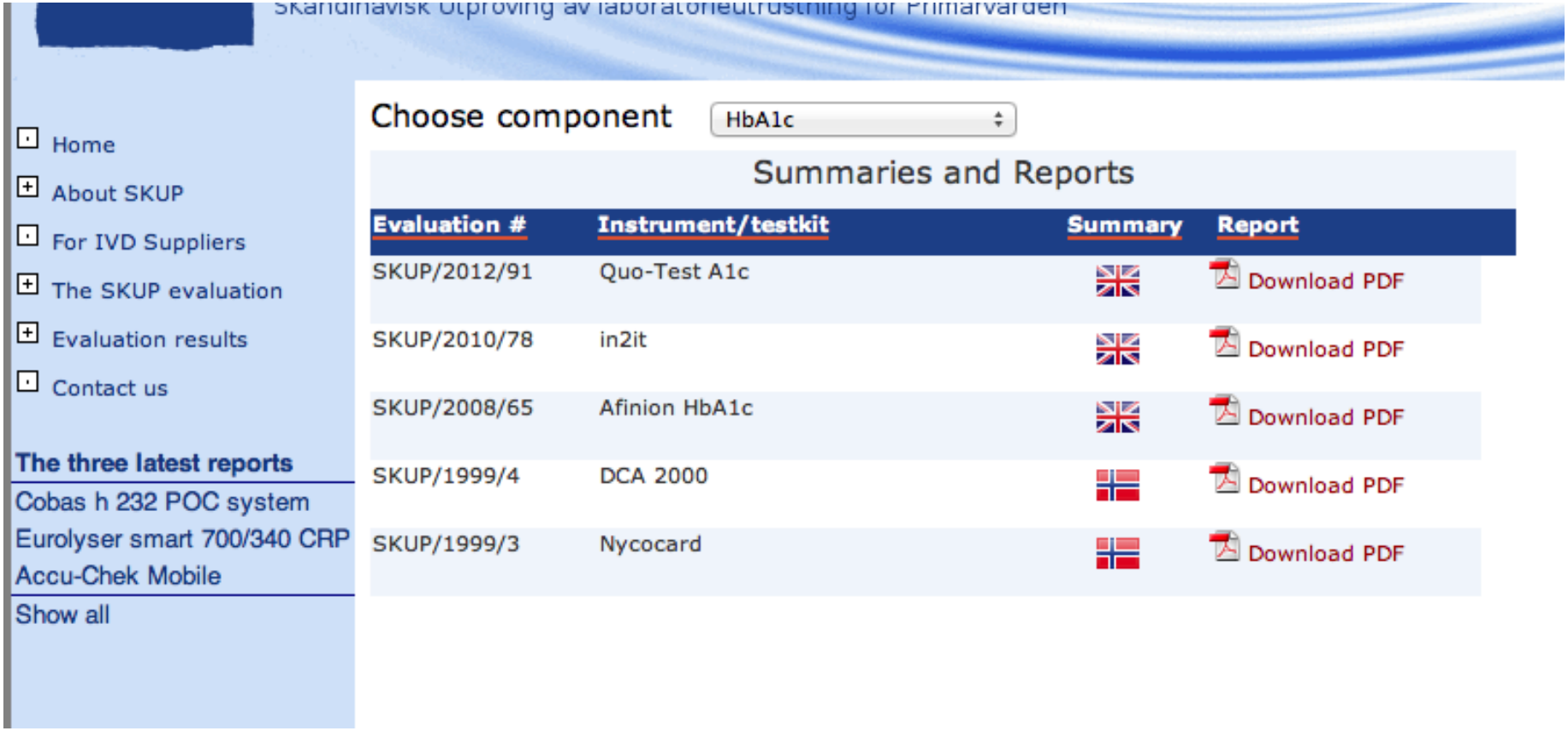
For HbA1c within-subject variation is small compared to analytical variation.

Therefore analytical variation is very important

Monitoring DM – influence of analytical quality of HbA1c

CV a	CVws	Start	Upper	Lower
5.0	1.7	9.1	8.0	10.2
3.0	1.7	9.1	8.4	9.8
1.0	1.7	9.1	8.7	9.5

HbA1c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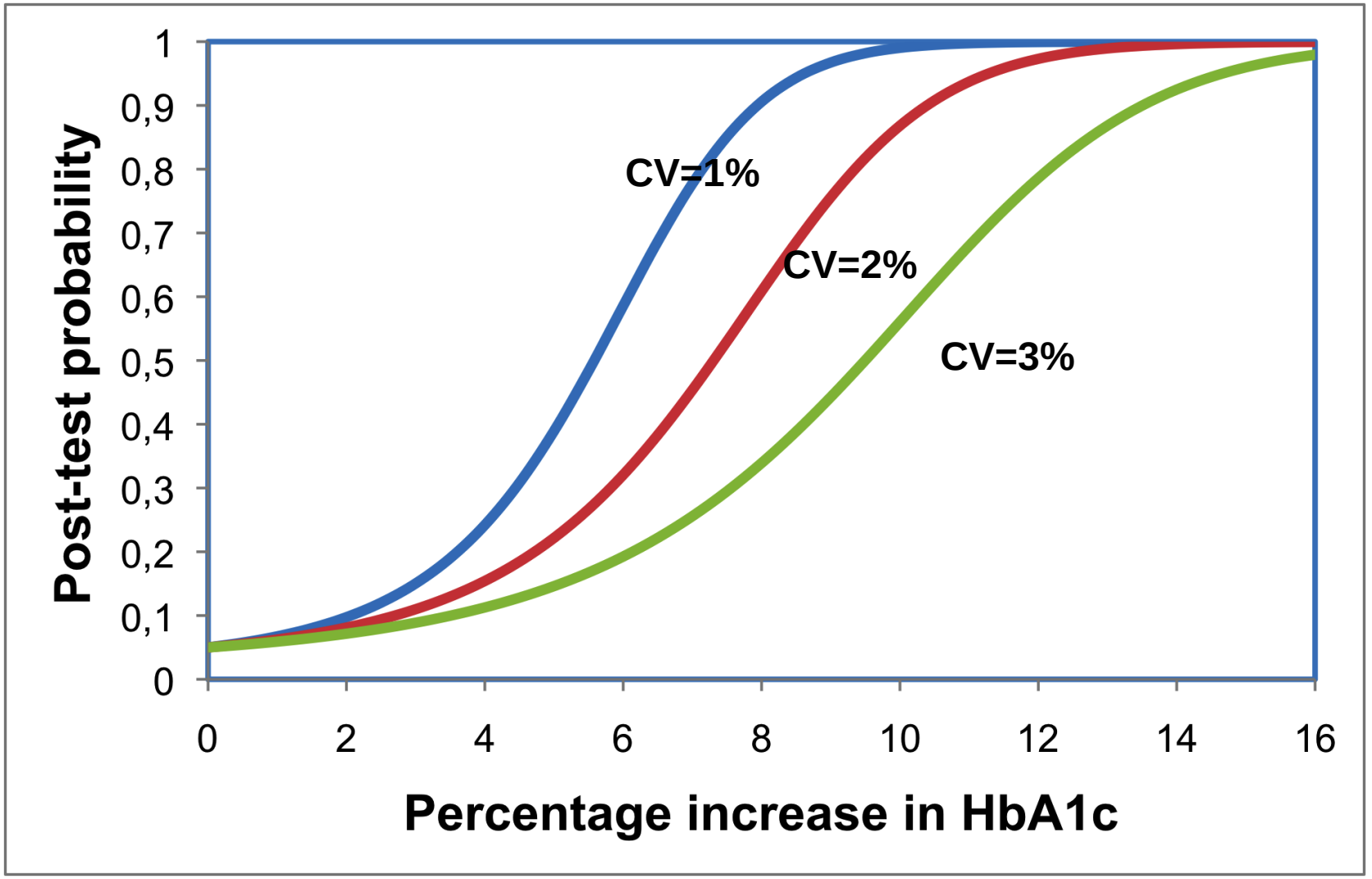
If we ask clinicians

-results from 7 countries -

Median percentage change in HbA1c to indicate poorer or better control was 0.7 % which corresponds to a 8% change in HbA1c from 9.1

This is in NGSP (%) units. In IFCC units (mmol/mol) the numbers are larger!!!

Pre-test probability of change: 5%



Clin Chem Lab Med 2008; 46: 157-64

Monitoring with HbA1c

Trueness is also of great importance since the results are compared with fixed limits and also goals for HbA1c for individual patients are set with fixed limits.

Quality specifications for diagnosing (will vary a little from country to country)

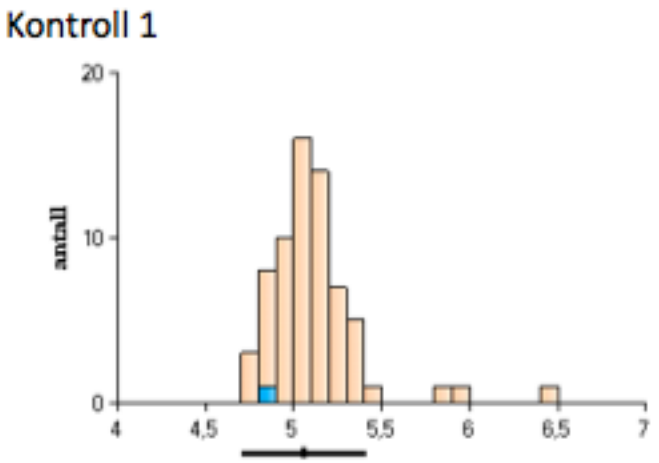
Methods used should be traceable to the IFCC referenc method.

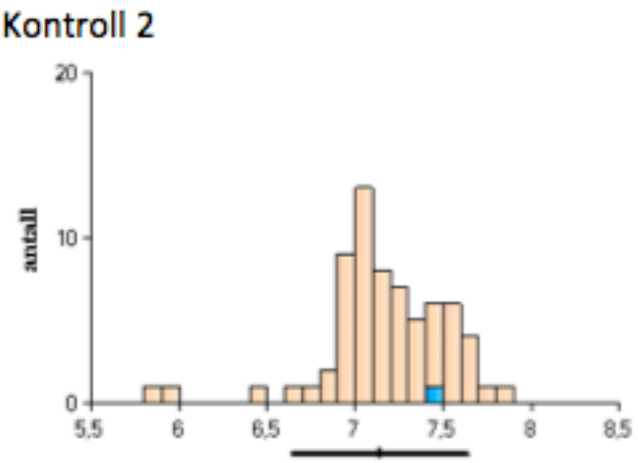
Total error less than 6% at the level of 6.5

Day to day within-batch internal quality control should have a CV < 2%.

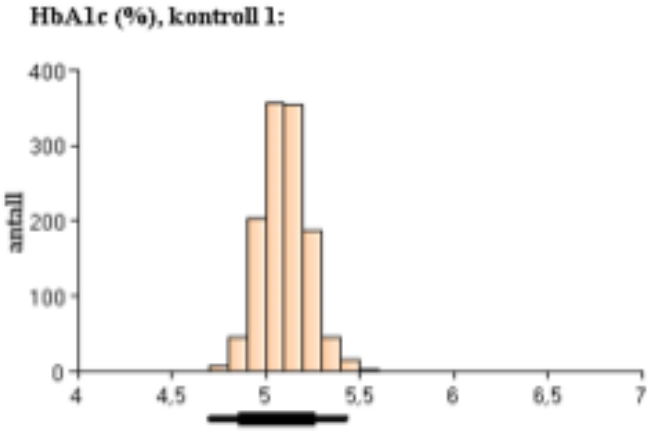
Between laboratory variation should be less than 3%

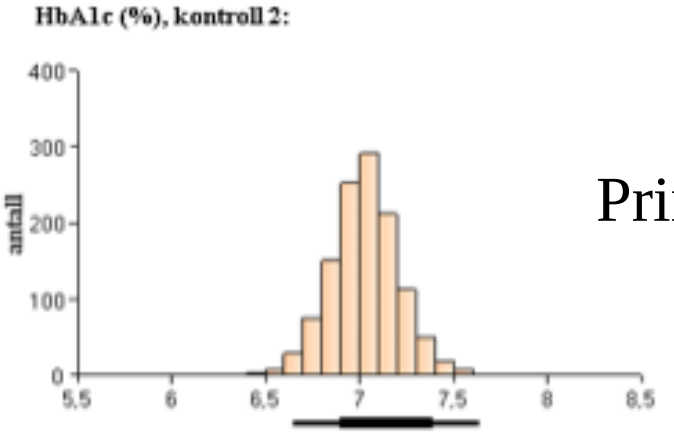
This is in NGSP (%) units. In IFCC units (mmol/mol) the numbers are larger!!!





Hospital





Primary health care

Papers in Press. Published August 19, 2013 as doi:10.1373/clinchem.2013.210781
The latest version is at http://hwmaint.clinchem.org/cgi/doi/10.1373/clinchem.2013.210781

Clinical Chemistry 59:12
000–000 (2013)

Diagnosing Diabetes Mellitus: Performance of Hemoglobin A_{1c} Point-of-Care Instruments in General Practice Offices

Una Ørvim Sølvik,[1*] Thomas Røraas,[2] Nina Gade Christensen,[2] and Sverre Sandberg[1,2,3]

BACKGROUND: Hemoglobin A_{1c} (Hb A_{1c}) measurement by hospital laboratory instruments, but not by point-

A_{1c} measurements that meet analytical quality specifications, these measurements can be recommended for

Number of participants

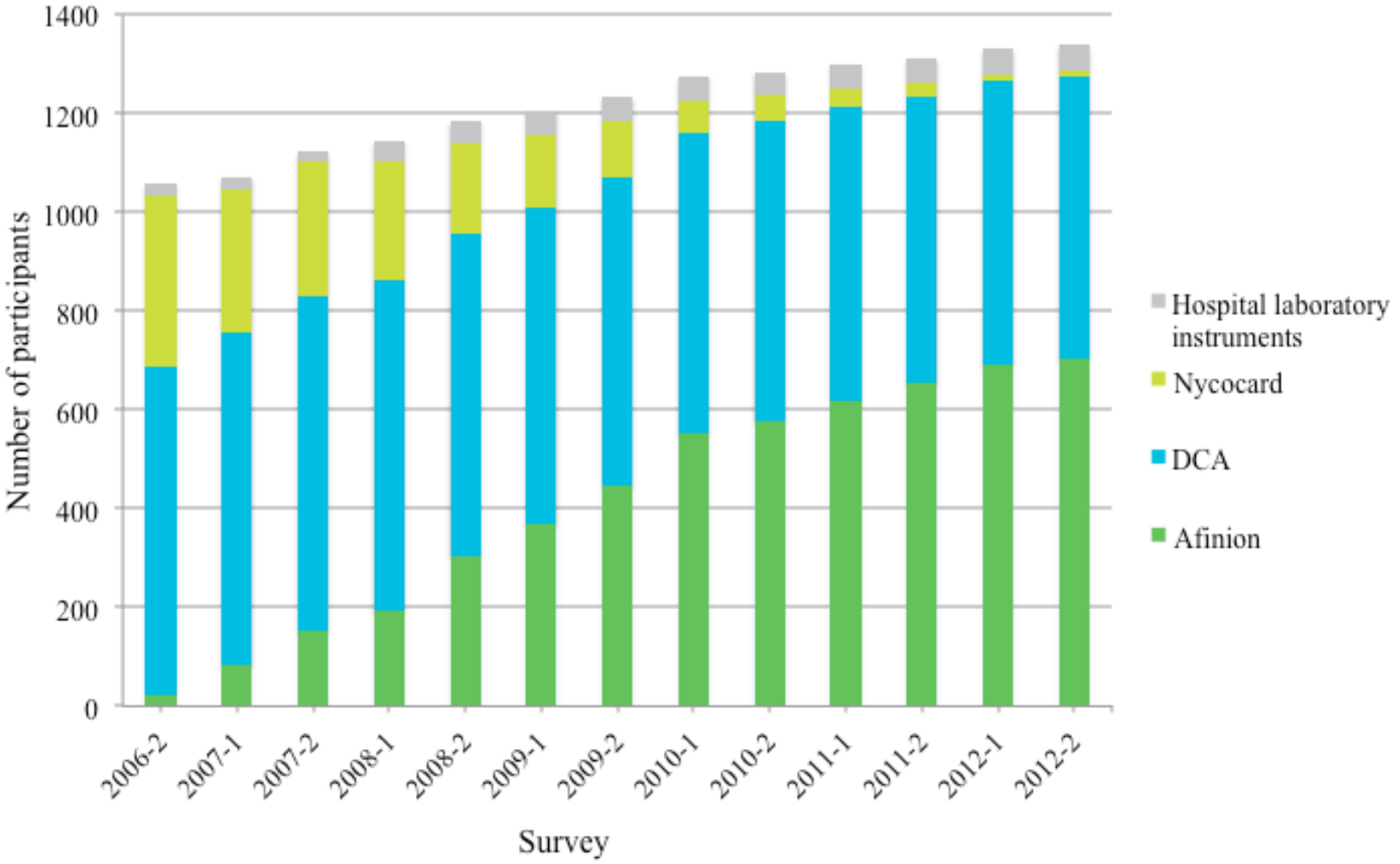
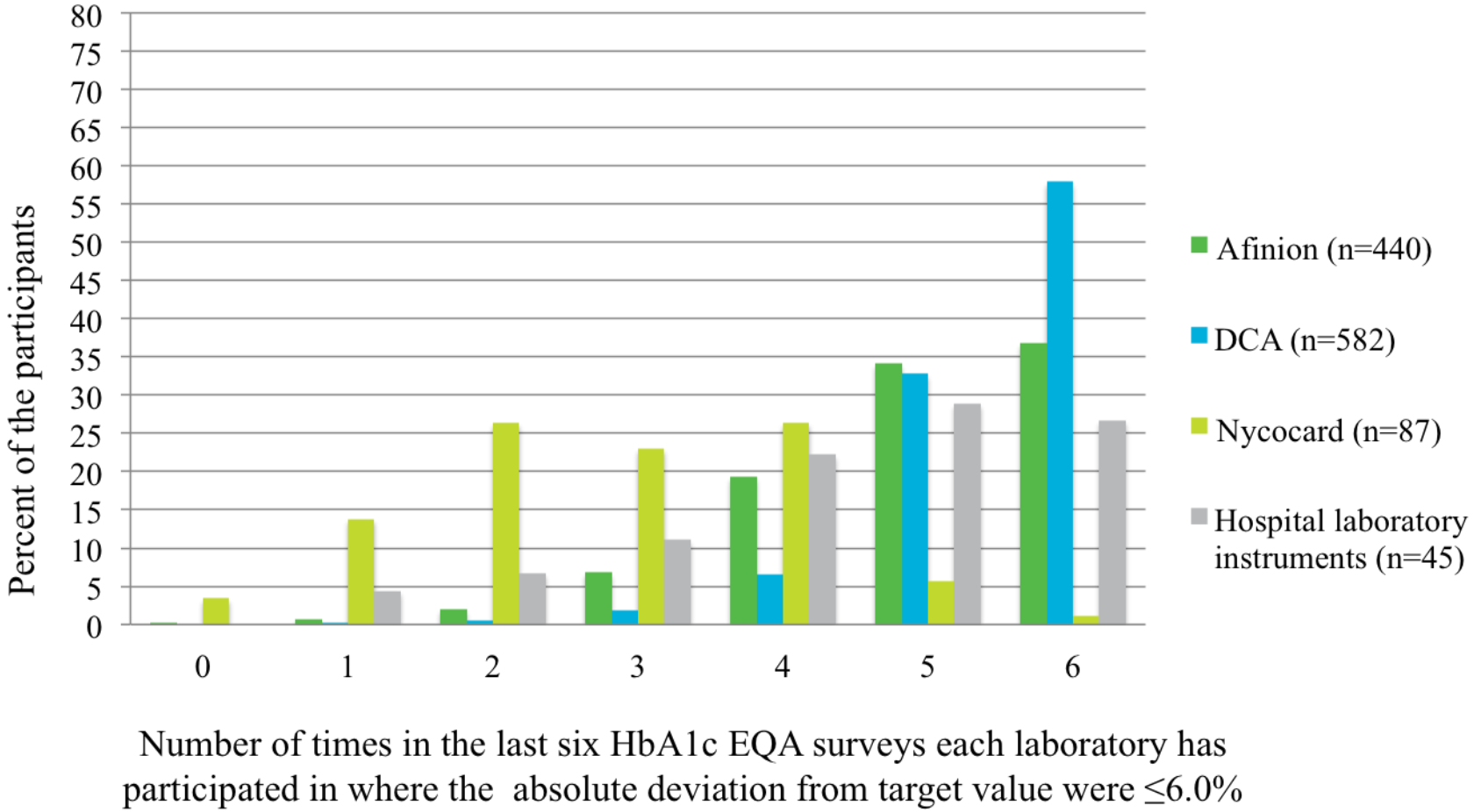


Figure 3A

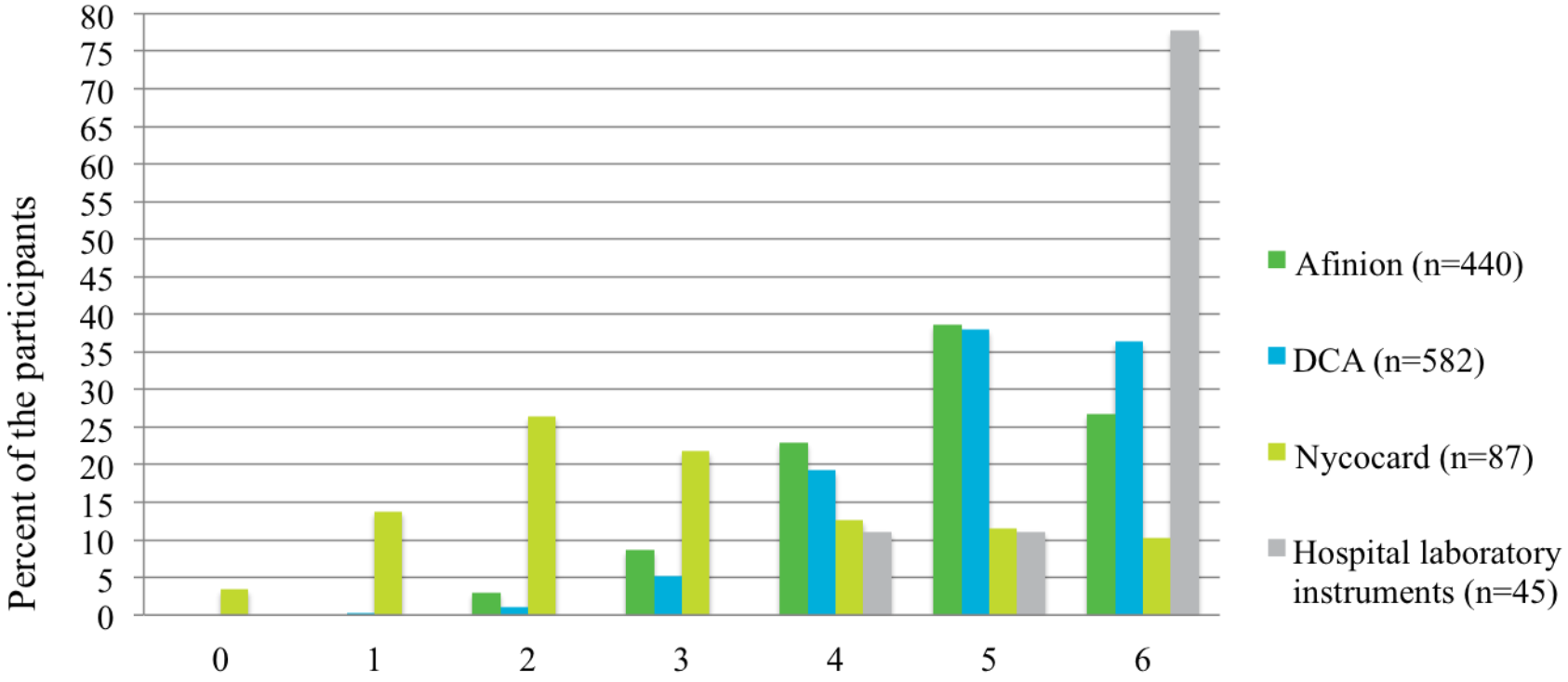
PHC compared to hospital laboratories – total error



Solvik et al. Clin Chem 2013, in press

Figure 3B

PHC compared to hospital laboratories – precision



Number of times in the last six HbA1c EQA surveys each laboratory has participated in where the absolute difference betweeen duplicates were ≤0.3% HbA1c

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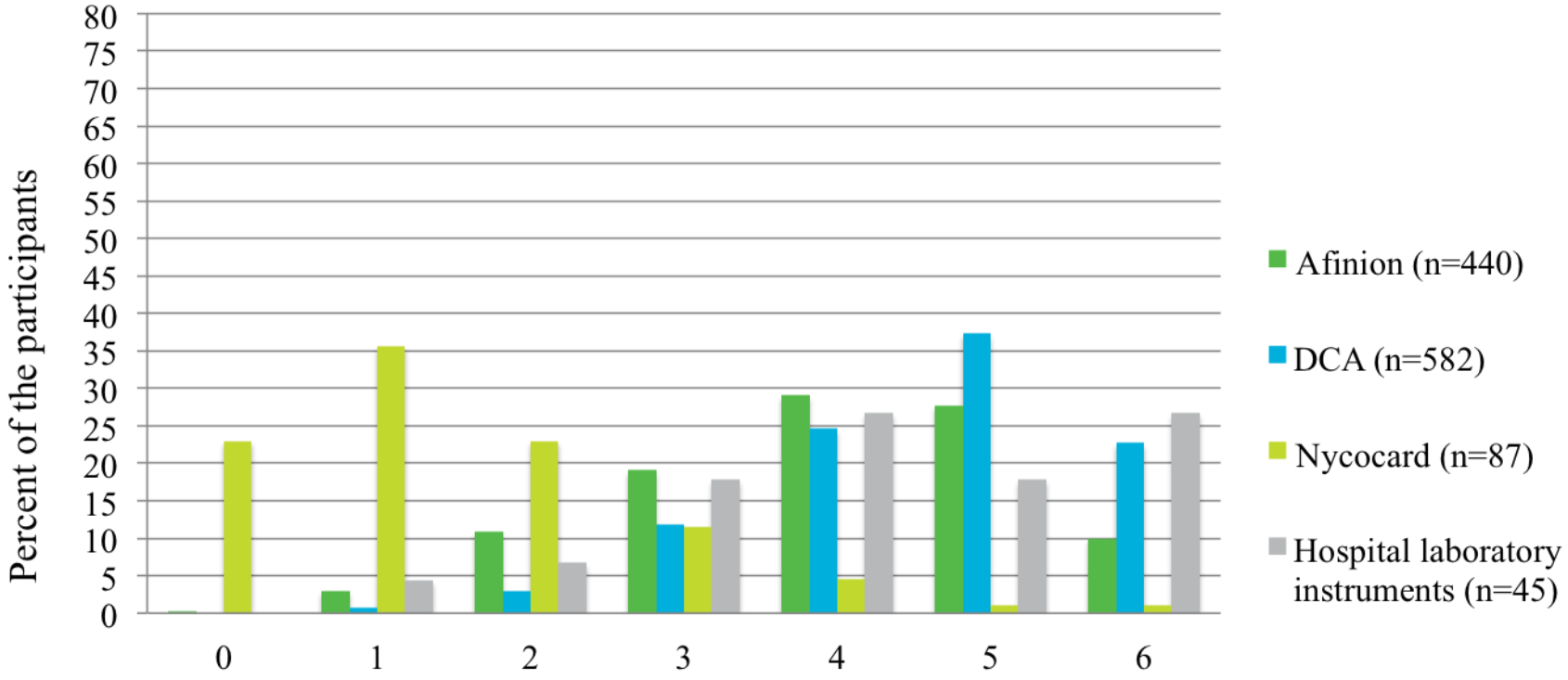
Figure 3C

PHC compared to hospital laboratories – total error and precision



Number of times in the last six HbA1c EQA surveys each laboratory has participated in where the absolute deviation from target were ≤6.0% and the absolute difference between duplicates were ≤ 0.3% HbA1c

Solvik et al. Clin Chem 2013, in press

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Presuppositions for diagnosing DM

- EQAS with commutable control material
- Routines for internal quality control
- Recommendations concerning what actions that should be taken to obtain the necessary quality
- Advises on which instruments to buy

Internal quality control

For POC instruments, an internal quality control should be analysed each day HbA1c is analysed

Can we approve instruments for diagnosing?

The quality is not only dependent on the instrument, but also on the participant performance. Therefore it is extremely important with participant focused information.

The quality specifications as well as other information is given in letters to GPs

General question: Can we use POC instruments to *diagnose* DM

General answer:

"Yes" if you can document your quality. But there will always be a "grey" zone (also using hospital instruments).

In general HbA1c should be better than glucose (if trueness is under control) since pre-analytical variables do not play a great role

So

– the main question is: Can we use POCT for monitoring and/or diagnosing diabetes mellitus.

- And if yes – what are the presuppositions for doing it.

So

– the main question is: Can we use POCT for monitoring and/or diagnosing diabetes mellitus. YES

- And if yes – what are the presuppositions for doing it. Fulfill quality specifications and have a system that can monitor your quality. Effective communication between lab people and the users.


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