i-CHROMA

A system for measurement of CRP

manufactured by BodiTech Med. Inc., Korea

Report from an evaluation organised by SKUP

The evaluation was performed on the request of Handelshuset Medic, Norge AS

SKUP/2008/61

SKUP in Denmark, Dept .BFG, Odense University Hospital, 5000 Odense C, Phone +45 6541 2865

The organisation of SKUP

Scandinavian evaluation of laboratory equipment for primary health care, *SKUP*, is a co-operative commitment of NOKLUS [1] in Norway, "Afdeling BFG"[2] in Odense, Denmark and EQUALIS [3] in Sweden. SKUP was established in 1997 at the initiative of laboratory medicine professionals in the three countries. SKUP is led by a Scandinavian *steering committee* and the secretariat is located at NOKLUS in Bergen, Norway.

The purpose of SKUP is to improve the quality of near patient testing in Scandinavia by providing objective and supplier-independent information on analytical quality and user-friendliness of laboratory equipment. This information is generated by organising SKUP *evaluations*.

SKUP offers manufacturers and suppliers evaluations of equipment for primary healthcare and also of devices for self-monitoring. Provided the equipment is not launched onto the Scandinavian market, it is possible to have a confidential pre-marketing evaluation. The company requesting the evaluation pays the actual testing costs and receives in return an impartial evaluation.

There are *general guidelines* for all SKUP evaluations and for each evaluation a specific *SKUP protocol* is worked out in co-operation with the manufacturer or their representatives. SKUP signs *contracts* with the requesting company and the evaluating laboratories. A *complete evaluation* requires one part performed by experienced laboratory personnel as well as one part performed by the intended users.

Each evaluation is presented in a *SKUP report* to which a unique *report code* is assigned. The code is composed of the acronym SKUP, the year and a serial number. A report code, followed by an asterisk (*), indicates a special evaluation, not complete according to the guidelines, e.g. the part performed by the intended users was not included in the protocol. If suppliers use the SKUP name in marketing, they have to refer to www.skup.nu and to the report code in question. For this purpose the company can use a logotype available from SKUP containing the report code.

SKUP reports are published at www.skup.nu and www.skup.dk. A detailed list of previous SKUP evaluations is included in this report.

[1] NOKLUS (Norwegian Quality Improvement of Primary Care Laboratories) is an organisation founded by Kvalitetsforbedringsfond III (Quality Improvement Fund III), which is established by The Norwegian Medical Association and the Norwegian Government. NOKLUS is professionally linked to "Seksjon for Allmennmedisin" (Section for General Practice) at the University of Bergen, Norway.

[2] "Afdeling for Biokemi, Farmakologi og Genetik" (Afdeling BFG) is the Department for Clinical Chemistry at the University Hospital in Odense, Denmark. Afdeling BFG in Odense and the national "Fagligt Udvalg vedrørende Almen Praksis" (Professional Committee for General Practice) have through an agreement created "the SKUP-division in Denmark". "Fagligt Udvalg vedrørende Almen Praksis" is a joint committee for "PLO", "Praktiserende Lægers Organisation" (General Practioners Organisation) and "Sygesikringens Forhandlingsudvalg" (Committee for Negotiations within the General Health Insurance System).

[3] EQUALIS AB (External quality assurance in laboratory medicine in Sweden) is a limited company in Uppsala, Sweden, owned by "Sveriges Kommuner och Landsting" (Swedish Association of Local Authorities and Regions), "Svenska Läkaresällskapet" (Swedish Society of Medicine) and IBL (Swedish Institute of Biomedical Laboratory Science).

Table of contents

1. Summary

Background
i-CHROMA™ CRP test is a Near Patient Testing system used for measuring the concentration of CRP in human blood, serum or EDTA-plasma. The system is primarily intended for use in the primary health care.
The *i*-CHROMA is based on quantitative immunoassay technology which is capable of quantifying single or multiple analytes at the same time by measuring laser-induced epifluorescence on a test cassette.

The aim of the evaluation
- Get a measure of the analytical quality of *i*-CHROMA in the interval of 2.5 to 300 mg/L achieved under standardised and optimal conditions in a hospital laboratory by an experienced laboratory technologist
- Evaluate the analytical quality of *i*-CHROMA in two Danish primary care centres
- Evaluate the user-friendliness when used in a hospital laboratory and in primary care

Materials and methods
Bias and repeatability were calculated from test results from 100 individuals tested with i-CROMA both with capillary and venous samples (EDTA plasma) in duplicates. After reducing the analysing time from five to three minutes, an additional 100 samples were analysed in duplicates. The designated comparison method was an immunoturbidimetric method, using Anti-CRP mouse monoclonal antibodies. The agglutination was measured turbidimetrically in a Modular P instrument from Roche.
The WHO standard 85/506 was used before, during and after the evaluation to adjust for bias. After a satisfying evaluation in an hospital laboratory the supplier decided to test the system also in the primary health care.

Results
After changing the analysing time of i-CHROMA to three minutes, 98% of the sample results were within a total error of ±26% from the comparison method results. The bias was less than ±10% in all levels. In the hospital the repeatability of *i*-CHROMA for both capillary and venous samples was 4-7%. In the primary care evaluation the repeatability was between 5,2% and 7,2% for capillary samples and 96% of the results had an acceptable deviation from the comparison method.
The user-friendliness was satisfying. Both primary care centres mentioned that it was convenient to do the analysing in one step.

Conclusion
The analytical quality goals (bias <10%, repeatability <10%, deviation from comparison method <26%) was fulfilled in the hospital laboratory evaluation for both capillary and venous samples as well as in primary care for the capillary results. The distribution of the measurements covered a concentration of CRP from 2.5 to 300 mg/L. The user-friendliness was assessed as satisfying both in the hospital laboratory and in the primary care.

2. Quality goals on test systems for P—CRP

2.1. Traceability for CRP results

All CRP tests should produce results that are traceable to the highest level of reference material, WHO 85/506.

2.2. Analytical quality goals

The international guidelines for analytical quality demands for CRP are few. The biological within-subject-variation is 42,2% CV and the biological between-subject-variation is 76,3% CV for healthy individuals. The reference interval is <3 mg/L. The desirable quality specifications[1-3] calculated from the biological variation gives high figures, imprecision 21,1% CV, bias ±21,8% and Total Error ±56,6%. As the CRP test is mostly used for non-healthy individuals with higher concentrations, more narrow quality limits are justified, as proposed below by SKUP for the present evaluation. In Denmark the CRP analyses used in primary health care and in hospital laboratories have different demands to quality[4]. Norway and Sweden have no similar demands.

SKUP:

Total Error ≤ Bias ±1,65 * CV Where bias < 10% and CV < 10%

In Denmark:

For CRP >15 mg/L:

Point Of Care Tests used in primary health care: Bias ≤±10% and CV ≤10%

Hospital laboratory methods, used as comparison methods: Bias ≤±3% and CV ≤5%

2.3. Quality goals for user-friendliness

Parameters evaluated: insert, time, quality control, operation of the test. The results of the evaluation are indicated as follows: not satisfactory = 0 point, less satisfactory = 1, satisfactory = 2. Each of the 4 areas has to achieve 2 points.

2.4. Summarized SKUP goals for the present evaluation

Table 1

		Goal
1	Imprecision	≤10% CV
2	Bias	≤±10%
3	Total Error	≤±26%
4	Waste/error results	2% or less
5	User-friendliness	satisfying

3. Materials and methods

3.1. The CRP test

Method	Formal full name of test	NPU code
	Plasma—C-reactive protein;mass concentration	NPU19748

3.2. The *i*-CHROMA CRP test

For a description of the *i*-CHROMA assay system, see [6-8]. The *i*-CHROMA CRP Test consist of a detector buffer, a disposable CRP strip cartridge, and an *i*-CHROMA reader. The *i*-CHROMA CRP test is used for measuring the amount of CRP in human blood, serum and EDTA-plasma. For measurement of CRP concentration in the fluorescence immunoassay system, fifteen µl of whole blood are mixed with 500 µl of detector buffer containing fluorescence labelled anti-CRP-mAb and anti-rabbit-IgG. If serum or plasma is used instead of whole blood the sample size is reduced to 10 µl.

The mixture is loaded onto the well of a test cassette and the test cassette is inserted in the *i*-CHROMA reader. After 3 minutes of immune reaction the test and the control line are scanned for acquisition of fluorescence intensity and the fluorescence intensity of the test is converted into a CRP concentration calculated by a pre-programmed calibration process. The result of the test is displayed on the reader. If the supplied printer is connected a printout is automatically made.

The principle of the fluorescence detection and calculation of the analyte concentration is shown in Figure 1

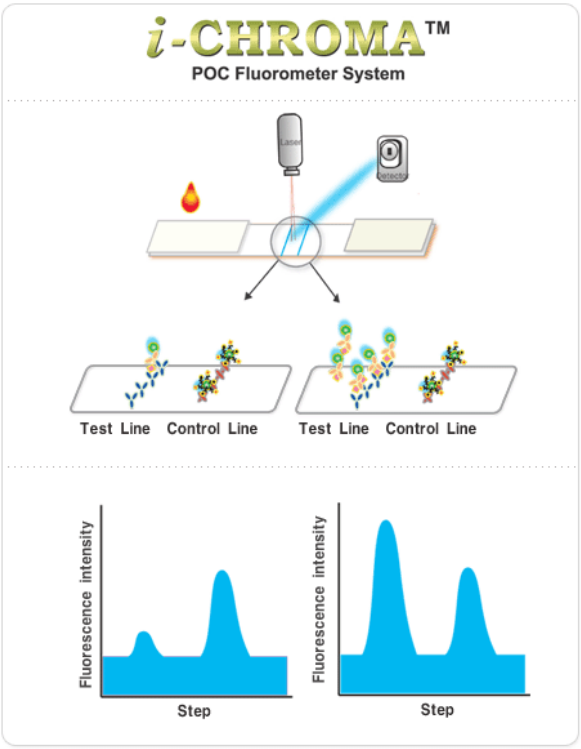

Figure 1: The figure shows the principle of the fluorescence detection and calculation of the analyte concentration (drawing from the manual)

Technology:

i-CHROMA is based on quantitative immunoassay technology which is capable of quantifying single or multiple analytes with a detection limit of pg/ml by measuring laser-induced epifluorescence on a test cassette. The assay system is comprised of a fluorescence reader and a cassette. The *i*-CHROMA technology utilizes a lateral flow-type assay method in which the analytes form immune complexes while moving on the separation medium (fig 1.). The concentration of the analyte in an unknown sample is calculated by comparing the test/control area ratio with a calibration curve obtained from different concentrations of analytes.

Content in the reagent box: 25 sealed test cassettes
1 ID Chip
25 Detection Buffer (separately packaged)
1 insert sheet

Also to be used:

Transfer pipettes 15 µl whole blood
10 µl for serum or plasma
75 µl for sample mixture

3.2.1. *Product information, i-CHROMA*[6]

i-CHROMA is manufactured by BodiTech Med. Inc., Korea

The suppliers in Scandinavia are:

Denmark and Norway:
Handelshuset Medic Norge
Storgt 112, 6 etg
3921 Porsgrunn , Norge

Phone: +47 35570300
Fax: +47 35570301
E-mail: info@medic24.no
www.medic24.dk

Sweden:
Handelshuset Medic AB
Solvarvsgatan 4
SE-507 40 Borås

Phone: + 46 33 23 00 99
Fax: + 46 33 23 00 28
E-mail: kundservice@medic24.se
www.medic24.se

3.2.2. *Technical data*

Technical data from the producer is shown in table 2.

Table 2. Technical specifications *i*-CHROMA™ Reader from the manufacturer

TECHNICAL DATA FOR THE *i*-CHROMA	
Working temperature	37˚C
Sample	Capillary, heparin or EDTA whole blood, serum
Sample volume	15 µL (whole blood) 10 µL (serum/plasma)
Units	µmol/L or mg/L
Measuring time	3 minutes
Measuring range	<2,5 mg/L to 300 mg/L
Memory	Only the last sample
Data output	On-board screen / Printer
Power supply	100-240V AC, 50/60Hz, 0.5-1.3A
Operating time with battery	
Dimensions	250 (L) x 185 (W) x 80 (H) mm
Weight	2 kg

See further details in attachment E

3.3. The designated comparison method

3.3.1. *Definition*

A designated comparison method is a fully specified method which, in the absence of a reference method, serves as the common basis for the comparison of a field method.

The designated comparison method is in the following text called the Comparison Method.

3.3.2. *Description of the comparison method in this evaluation*[7]

Instrument: Modular P, Roche

Traceability: The method is calibrated with Calibrator for automated systems (C.f.a.s.) from Roche. C.f.a.s. is traceable to a master lot calibrator, which is traceable to SI-units via the reference material – Certified Reference Material (CRM) 470

Method principle: Immunoturbidimetric analysis, anti-CRP mouse monoclonal antibodies bound to latex micro particles react with CRP in the sample and creates a new antigen/antibody complex. The agglutination is measured turbidimetrically (4).

It is a two point endpoint measurement. The first endpoint is just before reagent 2 is added. After adding reagent 2 (the antibody) the agglutination begins and the absorbance is read after about 5 minutes. The difference between measurements is used in the calculation of the measured result. A bi-chromatic measurement is done to minimise the interference (5).

Calculation of a measurement result: The concentration in a sample is calculated from the formula (5):

$Cx = [\{K(Ax-Ab)+Cb\}\bullet IFA]+ IFB$, where

Cx	=	concentration in a sample
K	=	factor of calibration
Ax	=	absorbance of actual sample
Ab	=	absorbance of Std. 1/Blank
Cb	=	concentration of Std. 1/Blank
IFA, IFB	=	the constant of the instrument for slope and intercept

3.3.3. *Procedures in the Dept. of Biochemistry, Pharmacology and Genetics, (BFG) Odense University Hospital OUH.*

The samples in the evaluation were analysed as the routine samples. However the samples in the evaluation were analysed in duplicates, which is a deviation from the routine. The samples were frozen in minus 70°C. The samples were analysed randomly in both Modular P instruments.

3.3.4. *Verification of the analytical quality of the comparison method*

Traceability:
Before, in the middle of and after the testing, the comparison method was checked with the WHO standard 85/506 in 3 levels: 2, 10 and 50 mg/L. The bias was calculated from the mean of the 12 measurements (two instruments) of the WHO standard 85/506.

Internal quality control:
Three pools of human plasma sample were produced for the evaluation, Low, Medium and Very High. They were run daily in the period 15-05-2007 to 13-09-2007

Low concentration: < 5 mg/L
Medium 15 – 20 mg/L
Very High > 100 mg/L

3.3.5. *Product information, the comparison method*

Instruments:
Modular P, serial number HQ 1360-30 and HQ 1360-20

Reagent :
CRP LX, Tina-quant®

Lot number 685157 before 23-05-2007
Lot number 686747 between 23-05-2007 and 6-8-2007
Lot number 689988 after 6-8-2007

Calibrators:
(C.f.a.s.) from Roche lot numbers: 176342. Calibrated 5-12-2006

3.4. Planning of the evaluation

3.4.1. *The scope of the evaluation according to the original planning*

- Bias and imprecision in capillary samples from 100 individuals tested with *i*-CROMA
- Bias and imprecision in venous samples (EDTA plasma) from 100 individuals tested in duplicate with *i*-CROMA
- Modular P should be used as comparison method for all the samples.
- Bias should be eliminated by using the reference material – Certified Reference Material (CRM) 470. (By a mistake the highest level of reference material, the WHO standard 85/506, was used instead.)
- Evaluation of the user-friendliness of *i*-CHROMA for venous and capillary samples
- After evaluation of the hospital testing a possible evaluation in primary care should be decided.

3.4.2. *Arrangements about the evaluation*
The manufacturer delivered all materials: instruments, test cassettes, instructions for use etc. The following was necessary:

For evaluation in the hospital laboratory:
2 instruments: 1 for the hospital (PFR06K09510) and 1 for back-up

2 batches of test cassettes: WCL2A02, WCL2A03

After the evaluation in hospital the supplier changed the reading time from 5 minutes to 3 minutes.

A testing to make sure, that the previous testing was stil valid was performed by compare the same bloodsamples in the comparison method, the i-CHROMA system 5 minutes and in the i-CHROMA 3 minutes.

For this we used the i-CHROMA reader PFR06K09515 (3 minutes) and the i-CHROMA reader PFR06K09510 (5 minutes).

Lot devices: WCL 2A02 and WCL 2A03 (5 minutes)
Lot devices: WDF1A04 (3 minutes)

For the evaluation in the primary care:

2 instruments were used: *i*-CHROMA PFR06K09515 and PFR06K09511
2 batches of test cassettes WDF1A04, WDK4A05, expir. 2009.06

In total three *i*-CHROMA instruments and four batches of test cassettes were used.

Table 3 Number of tested samples

The evaluation in an hospital laboratory	
Reading time 5 minutes	
Practise in the instrument before testing	November 2006 ~ 100
Venous samples	100 x 2 = 200
Capillary samples	100 x 2 = 200
Control samples	76 x 2+18 = 170
Experiments	~ 120
Additional testing, reading time 3 minutes	
Venous samples	101 x 1 = 101
Capillary samples	101 x 2 = 202
Control samples	13 x 3 = 39
The evaluation in primary care,	
Reading time 3 minutes	
Capillary samples	40 x 2 x 2 = 160
In total	~1300 cassettes were tested
Waste	< 5 ~ <0,5%

3.4.3. *Evaluation sites and persons involved*

Responsible from SKUP
Esther Jensen
Phone +45 6541 2865 or +45 6541 1694
Fax +45 6541 1911
E-mail skup@skup.dk

Co-worker
Nina Brøgger
Phone +45 6541 1955

Responsible for the comparison method
Poul Jørgen Jørgensen, civil engineer

3.4.4. *The recruitment of the patients/samples*

Due to the short half-live of CRP in vivo the capillary sample for *i*-CHROMA and the venous sample for the comparison from the same individual method were drawn within 30 minutes.

An optimal distribution of sample concentrations was achieved by including 40 out-patients and 60 in-patients from the medical department of infectious disease.

Table 4 The comparison method, distribution of the concentrations in the samples

CRP (mg/L)	<5	5 to <15	15 to <50	50 to <100	>100
number	31	22	15	15	18

According to the manufacturer both capillary samples and serum/plasma samples can be used. Therfore a comparison between capillary sample and serum/plasma sample results was done in the evaluation.
According to the manufacturer the following sample volumes should be used:
15 µL of capillary blood or 10 µL serum/plasma.

Sample handling
The venous samples were drawn and treated as routine samples. Then they were analysed as duplicates with the Comparison Method.

Analysing with *i*-CHROMA
The samples were analysed in duplicates with *i*-CHROMA. First the two capillary samples, then the EDTA venous sample. The instruction in manual was followed

Quality assurance with *i*-CHROMA
Pools of human serum were established. The concentrations were <5, 15-20 and >100 mg/L. Two of the samples were run in duplicates every day of testing.

Analysing in the comparison method
The samples was analysed as duplicates with Modular. Time from blood sampling to analysing: maximum 8 hours.

Comparison method, external QC
The WHO standard 85/506 was used before, during and after testing. Therefore the External QC is not shown.

3.5. Evaluation procedure

3.5.1. *Training*
Nina Brøgger was trained by MEDIC in November 2006. She performed the testing using *i*-CHROMA in the Department of clinical biochemistry. In May Kjell Myrseth and Frode Skæveland, MEDIC, and Moon Joung Dae, from the manufacturer Boditech, Korea, were in Odense for the final training and to clarify which sample volume of whole blood that should be used in the evaluation.

3.5.2. *Evaluations procedure in the hospital laboratory (standardised and optimal conditions)*
The capillary whole blood results were compared to the venous whole blood results and the comparison test.
Control samples were run in the *i*-CHROMA instrument and the comparison method.

The WHO-standard 85/506 was run as check samples before, during and after the test in *i*-CHROMA and the comparison method.

3.5.3. *Evaluations procedure in the primary health care*
The capillary whole blood samples (duplicates) were compared to the comparison test (single measurement).

Control samples were run in the *i*-CHROMA method.

The WHO standard 85/506 was run before and after the test in the comparison method.

4. Statistical expressions and calculations

4.1. Statistical terms and expressions

4.1.1. *Precision*

The common used terms within-series imprecision and between-series imprecision are often misinterpreted. Especially the terms between-series and between-day imprecision are often not precisely defined. In this report, the terms are replaced by the precisely defined terms *repeatability and reproducibility*.

Repeatability is the agreement between the results of consecutive measurements of the same component carried out under identical measuring conditions (within the measuring series).

Reproducibility is the agreement between the results of discontinuous measurements of the same component carried out under changing measuring conditions over time. The reproducibility includes the repeatability. The two terms are measured as **imprecision**. Precision is descriptive in general terms as “good”, “acceptable” and “poor”, whereas imprecision is expressed by means of the standard deviation (SD) or coefficient of variation (CV). SD is reported in the same unit as the analytical result and CV is usually reported in percent. The imprecision will be summarised in tables.

4.1.2. *Accuracy*

Accuracy is the closeness of agreement between the result of one measurement and the true value. Inaccuracy is a measure of a single measurements deviation from a true value, and implies a combination of random and systematic error (**analytical imprecision** and **bias**). Inaccuracy, as defined by a single measurement, is not sufficient to distinguish between random and systematic errors in the measuring system. Inaccuracy can be expressed as **total error**. The inaccuracy will be illustrated by difference plots with quality goals for the total error shown as deviation limits in percent.

4.1.3. *Trueness*

Trueness is the agreement between an average value obtained from a large number of measuring results and a true value. Trueness is measured as **bias** (systematic errors). Trueness is descriptive in general terms (good, poor), whereas bias is the estimate, reported in the same unit as the analytical result or in %. The bias at different concentration levels will be summarised in tables.

4.2. Statistical calculations

4.2.1. *Number of samples*

100 capillary samples in duplicate. For at least 40 of these patient-samples, venous blood samples in duplicates are also analysed.

4.2.2. *Statistical outliers*

All the results are checked for outliers according to Burnett[2], with repeated truncations. The model takes into consideration the number of observations together with the statistical significance level for the test. The significance level is often set to 5 %, so also in this evaluation. Where the results are classified according to different concentration levels, the outlier-testing is done at each level separately. Statistical outliers are excluded from the calculations. Possible outliers will be commented on under each table.

4.2.3. *Missing or excluded results*

None

4.2.4. *Calculations of imprecision based on duplicate results*

The imprecision was calculated by use of paired measurements, based on the following formula:

$$SD = \sqrt{\frac{\sum d^2}{2n}}$$, d = difference between two paired measurements, n = number of differences

Even if this formula is based on the differences between the paired measurements, the SD is still a measure of the imprecision of single values, and completely comparable with the more commonly used calculation based on repeated measurements of only one sample. The assumption for using this formula is that no systematic difference between the 1st and the 2nd measurement is acceptable. There is no systematic difference in concentration between the paired measurements at *i-CHROMA* in this evaluation.

4.2.5. *Calculation of trueness*

To measure the trueness of the results at *i*-CHROMA, the average bias at three concentration levels is calculated based on the results obtained under standardised and optimal measuring conditions. A paired t-test is used to compare the mean values of the duplicate results from the comparison method and the mean values from *i*-CHROMA.

4.2.6. *Calculation of accuracy*

To evaluate the accuracy of the results at *i*-CHROMA, the agreement between *i*-CHROMA and the comparison method is illustrated in difference plots. In the plots the x-axis represents the mean value of the duplicate results at the comparison method. The y-axis shows the difference between the first measurement at *i*-CHROMA with three lots and the mean value of the duplicate results at the comparison method.

5. Results and discussion

5.1. Analytical quality of the comparison method

5.1.1. *The precision of the comparison method*

Table 5. Internal quality control (patient pool) during 20 days from 9. May to 13 September

Comparison method Modular P					
			Repeatability		Reproducibility
	N	mean (mg/L)	CV (%)	CI 95%	CV (%)
Control 1	24	4,1	2,7	2,1 to 3,7	7,9
Control 2	24	18,2	2,0	1,6 to 2,8	4,2
Control 3	23	183,6	0,5	0,4 to 0,8	2,2

Discussion: Repeatability and reproducibility of CRP in Modular P fulfilled the demands at the concentrations 18 and 180 mg/L. At 4 mg/L the reproducibility was 7,9% and thus higher than demand of 5%. (The laboratory normally report low results to clients as '<5,0 mg/L'.)

5.1.2.

Table 6. The trueness of the comparison method

Date	WHO 85/506	WHO 85/506 measured	CV%	bias %	Comparison instrument1 Modular1.1	Modular1.2	Comparison instrument2 Modular2.1	Modular2.2
15.05.07					1,9	1,9	1,7	1,8
23.07.07	2,0	2,0	32,4	1,2	1,8	1,8	1,5	1,6
13.09.07					1,8	1,7	3,6	3,2
15.05.07					9,6	10,3	9,5	9,5
23.07.07	10,0	9,7	7,5	-2,8	9,3	9,2	9	9
13.09.07					9,6	9,4	11	11,2
15.05.07					52,1	47,8	52,2	51,6
23.07.07	50,0	51,8	4,4	3,6	52,3	51,8	49,6	51,1
13.09.07					51,4	50,1	56	55,9

Discussion: The trueness of the comparison method is from -2,8% to 3,65%. The CV% for the low concentration of 2,0 mg/L in Modular is 32%. (In routine are low concentrations reported as <5 mg/L.)

5.1.3. *The repeatability of the comparison instrument Modular P is demonstrated in table 7.*

Table 7. Repeatability, the comparison method, Modular P in the evaluation

CRP (mg/L) Modular P Dept. BFG	CRP (mg/L) mean (range) Modular P Dept. BFG	CV % (95 % C.I.)	n	Outliers
<5,25	2,29 (<0,1 — 5,25)	16,0 (12,8 —21,3)	33*	0
5,4 – 41,1	16,7 (5,4 — 41,1)	1,9 (1,5 — 2,5)	34	0
>42,6	132 (42,6 — 353)	1,4 (1,0 — 2,1)	34	0
2-353	55,9 (2,0 — 353)	2,4 (2,1—2,9)	84	

** one sample <0,1 mg/L excluded*

Discussion: The CV% for the 16 samples with a concentration between 0,1 and 2,0mg/L was very high in Modular P. For the 84 samples >2,0 mg/L the CV% was 2,4%.

5.2. Analytical quality of *i*-CHROMA in the hospital laboratory

Reading time 5 minutes.

Table 8. Repeatability for *i*-CHROMA with capillary samples.

CRP (mg/L) Modular P Dept. BFG	CRP (mg/L) mean (range) i-CHROMA dept. BFG	CV % (95 % C.I.)	n	Outliers
<5,25	<2,5 ((<2,5) — 6,2)	6,2 (4,6 — 9,5)	33*	0
5,4 – 41,1	16,4 (5,0 — 44,7)	6,8 (5,5 — 8,9)	34	0
>42,6	138 (45 — (>300))	5,6 (4,5 — 7,5)	34**	0
2,5—300	60,2 (2,55 — 272)	6,2 (5,4 — 7,4)	80	0

**Excluded: 16 duplicate measurements <2,5 mg/L. **two samples >300 mg/L, two samples not in duplicate, in total 20 samples*

Table 9. Repeatability for *i*-CHROMA with venous samples.

CRP (mg/L) Modular P Dept. BFG	CRP (mg/L) average (range) i-CHROMA dept. BFG	CV % (95 % C.I.)	n	Outliers
<5,25	<4,08 ((<2,08) — 6,05)	7,0 (5,1 — 11,3)	33*	0
5,4 – 41,1	15,62 (4,45 — 39,1)	4,7 (3,9 — 6,3)	34	0
>42,6	137 (41 — (>300))	6,8 (5,5 — 9,0)	34**	0
62,4	2,85—(>300)	6,1 (5,3—7,2)	79	0

**Excluded: 13 duplicate measurements <2,5 mg/L. **three samples >300 mg/L*

The excluded samples with values <2,5 mg/L was in good accordance with the Modular P results, so was the five results >300 mg/L in *i*-CHROMA; the values in Modular P was 267, 325 mg/L and >500 mg/L respectively.

The demands to repeatability, less than 10%, was fulfilled in all concentration levels for capillary and venous samples with CV% from 4,7 to 7,0% for the *i*-CHROMA instrument.

5.2.1.

Table 10. Internal quality control (patient pool) 20 days from 9 May to 13 September

i-CHROMA					
			Repeatability		Reproducibility
	N	mean (mg/L)	CV (%)	CI 95%	CV (%)
Control 1	24	4,5	5,6	4,4 to 7,8	7,8
Control 2	24	19,4	5,1	4,0 to 7,2	5,4
Control 3	23	190,7	12,6	9,9 to 17,8	12,3

Discussion: Repeatability and reproducibility of CRP with *i*-CHROMA fulfil the demands for the control values at 4 and 20 mg/L. For the control at the high CRP concentration the reproducibility was 12% (CI 95% 9,9 to 17,8). 12% is above the quality goal of 10%; however the confidence interval included 10%. A CV% of 12% at the concentration at 190 mg/L has less clinical importance.

5.2.2. *The trueness of i-CHROMA in a hospital laboratory*

The trueness of i-CHROMA is calculated from results achieved by one laboratory technologist in a hospital laboratory. 101 patients participated in the evaluation.

The results are shown in table 11 and 12.The raw data is shown in attachment 1

Bias is the mean difference between *i*-CHROMA and the comparison method, based on the mean of each duplicate with both methods. The results are achieved under standardised and optimal conditions. Only samples >2,5 mg/L and <300 mg/L in both methods are included. Table 11 demonstrates the results for capillary samples and table 12 for venous samples from the same individuals.

Table 11. Bias with *i*-CHROMA. Capillary Samples

CRP (mg/L) Modular P Dept. BFG	CRP (mg/L) mean (range) *i*-CHROMA	*i*-CHROMA Mean deviation from the comparison method (95 % C.I.) (%)	N	Outliers
<5,25	3,85 (2,6—6,2)	13,7 (7,3—20,1)	33*	0
5,4 – 41,1	16,4 (5,0—44,7)	-2,7 (-6,4—0,1)	34	0
>42,6	138 (45,2—272)	13,0 (1,2—18,3)	34**	0
2,5 to 500	60,2 (2,6—272)	6,5 (3,4—9,6)	81	0

Exclusion: *of the 33 samples 17 duplicate samples had at least one sample <2,5 mg/L.** two samples had values >300 mg/L and one result was not in duplicate

Table 12. Bias with *i*-CHROMA. Venous Samples

CRP (mg/L) Modular P Dept. BFG	CRP (mg/L) mean (range) *i*-CHROMA	*i*-CHROMA Mean deviation from the comparison method (95 % C.I.) (%)	N	Outliers
<5,25	4,08 (2,9--6,1)	13,5 (7,8—19,2)	33*	0
5,4 – 41,1	15,6 (4,5—39,1)	-5,8 (-9,0 –(-2,5)	34	0
>42,6	137 (41,0—279)	13,9 (9,4—18,4)	34**	0
<2,5 to >300	62,4 (2,6—272)	5,5 (2,2—8,7)	81	0

*Exclusion: 18 duplicate samples had at least one sample <2,5 mg/L.** three samples had five values >300 mg/L

Discussion: The bias changes between the three level groups. It is positive for the low and the high group and negative for the medium level group. The reason is not known.

5.2.3. Figure 2. The accuracy of *i*-CHROMA (standardised and optimal conditions)

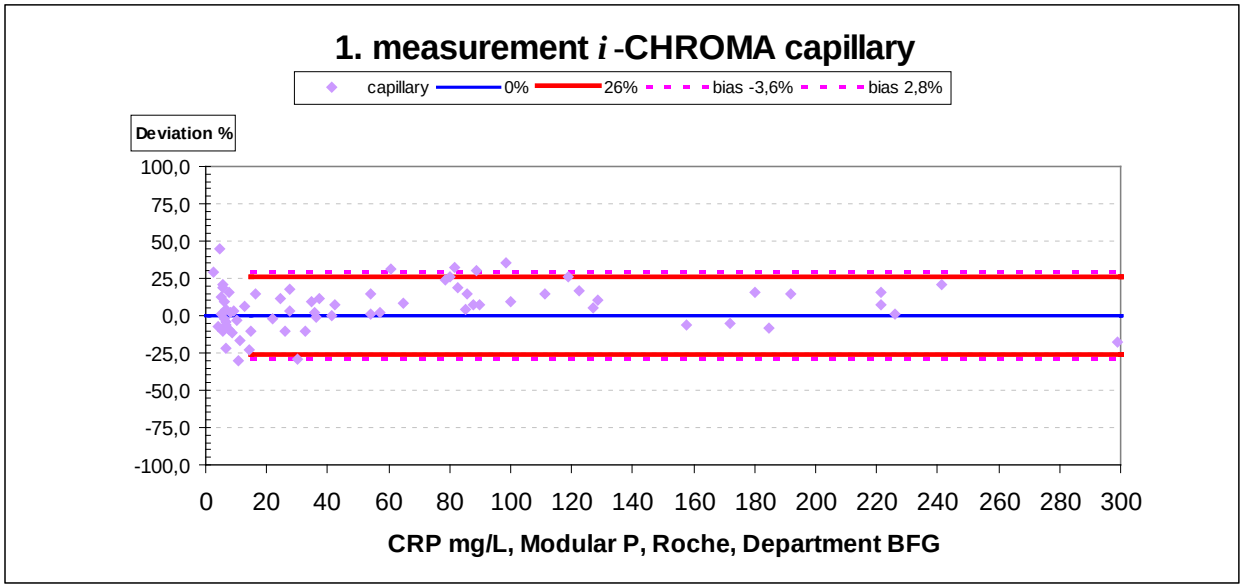

Figure 2. Accuracy of CRP in capillary samples with *i*-CHROMA under standardised and optimal measuring condition. The x-axis represents the mean value of the duplicate results with the comparison method. The y-axis shows the deviation between the first measurements on *i*-CHROMA and the mean value of the duplicate results with the comparison method, n = 101.
The comparison method had a bias of -2,8 to 3,6%. The dotted line is the allowed deviation plus the bias. 98 of 101 results fulfil the demands when corrected for bias in the comparison method.

Figure 3.

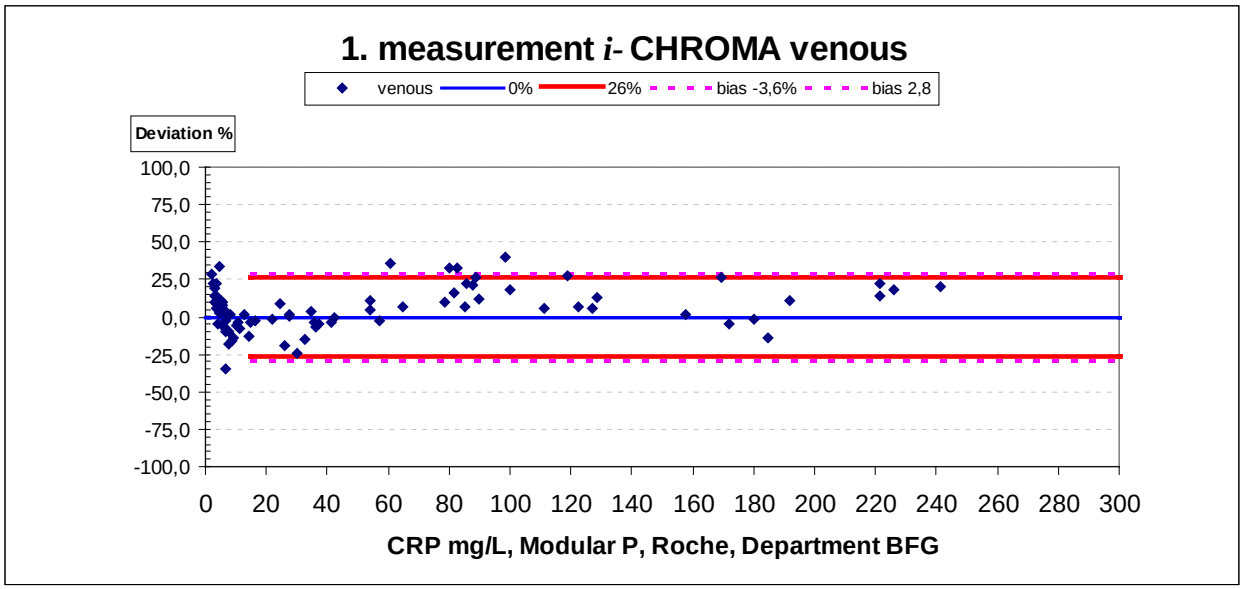

Figure 3. Accuracy of CRP in venous samples with *i*-CHROMA under standardised and optimal measuring condition. The x-axis represents the mean value of the duplicate results on the comparison method. The y-axis shows the deviation between the first measurements on *i*-CHROMA and the mean value of the duplicate results at the comparison method, n = 101.
The comparison method had a bias of -2,8 to 3,6%. The dotted line is the allowed deviation plus the bias. 96 of 101 results fulfil the demands when corrected for bias in the comparison method.

Discussion: A positive bias is seen for the low concentrations and for the concentrations above 50 mg/L. The reason for this is unknown.

The supplier changed the measuring time of the *i*-CHROMA from 5 to 3 minutes after the evaluation in hospital.

5.3. Results after change of the measuring time of *i*-CHROMA

It was agreed that 100 venous samples should be tested in the comparison method and in *i*-CHROMA to demonstrate that bias, repeatability and reproducibility of CRP in *i*-CHROMA also after change of measuring time fulfil the demands.

Table 13. Repeatability, the *i*-CHROMA method 3 minutes, venous samples.

CRP (mg/L) Modular P Dept. BFG	CRP (mg/L) mean (range) *i*-CHROMA	CV % (95 % CI)	n	Outliers
0,4—19,1	11,9 (2,5—20,2)	6,9 (5,5—9,4)	33*	0
20,0—41,5	30,4 (19,5—44)	6,7 (5,5—8,8)	35	0
41,7—>500	74,6 (34,6—261)	5,9 (4,8—8,0)	33**	0
3,1—240	39,6 (2,5—261)	6,5 (5,7—7,7)	92	0

Exclusion: *duplicates <2,5 in six samples. ** three samples >300 mg/L

The demands to repeatability (<10%) is fulfilled for *i*-CHROMA after the recalibration from 5 to 3 minutes.

Table 14. 'Bias', *i*-CHROMA method 3 minutes, venous samples.

CRP (mg/L) Modular P Dept. BFG	CRP (mg/L) mean (range) *i*-CHROMA	*i*-CHROMA Mean deviation from the comparison method (95 % C.I.) (%)	n	Outliers
0,4 — 19,1	11,9 (<2,5—20,2)	-0,6 (-5,2—4,0)	33*	0
20,0 — 41,5	30,4 (19,5—44)	4,8 (0,1—9,5)	35	0
41,7 — >500	74,6 (34,6—261)	-7,5 (-10,8—(-4,1))	33**	0
3,1 — >500	39,6 (2,5—261)	-0,8 (-3,4—1,8)	92	0

Exclusion: * for six samples both duplicates were <2,5 mg/L ** for three samples both duplicates were >300 mg/L.

The calculation of bias is not a 'true bias calculation' as the comparison method was not measured in duplicates.

After the change of measuring time *i*-CHROMA fulfilled the demands for mean deviation <10%.

Figure 4.

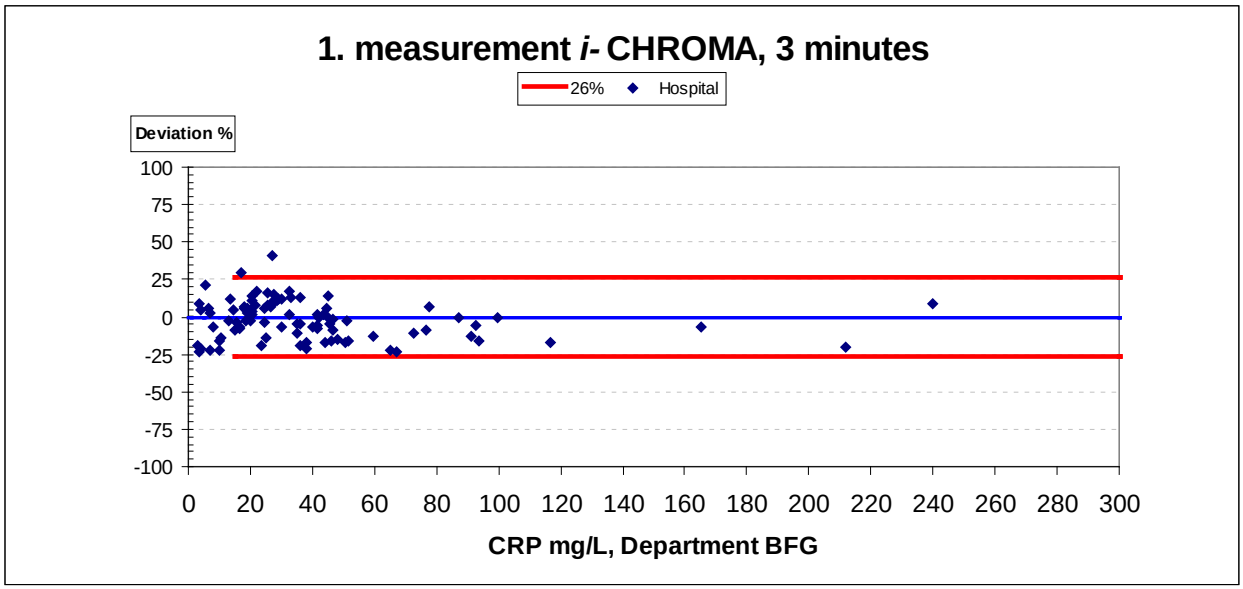

Figure 4. Accuracy in venous samples under standardised and optimal measuring condition. The x-axis represents the mean value of the duplicate results on the comparison method. The y-axis shows the deviation between the first measurements on *i*-CHROMA and the mean value of the duplicate results at the comparison method, n = 100. 98 of 100 results fulfil the demands.

5.4. Analytical quality of *i*-CHROMA used in primary health care

Two primary health care centres evaluated *i*-CHROMA . The staff in the participating centres were nurses. They were trained less than one hour and performed 5-10 tests before beginning the evaluation.

Table 15. Repeatability, Primary care, *i*-CHROMA method 3 minutes, capillary samples.

CRP (mg/L) Modular P Dept. BFG	CRP (mg/L) mean (range) *i*-CHROMA	CV % (95 % CI)	n	Outliers
Dept. BFG	Primary care A			
0,4—2,8	<2,5 in duplicate	—	20	0
3,0—120	14,6 (2,7—83)	7,2 (5,5—10,5)	20	0
	Primary care B			
0—2,6	<2,5 in duplicate	—	16	0
3,1—100,7	21,0 (3,3—94)	5,2 (4,1—7,4)	24	1*

* one duplicate result 15,7 and 5,2. The demands for repeatability (<10%) is fulfilled for *i*-CHROMA after the recalibration.

Table 16. Bias, Primary care, the *i*-CHROMA method 3 minutes, capillary samples.

CRP (mg/L) Modular P Dept. BFG	CRP (mg/L) mean (range) *i*-CHROMA	*i*-CHROMA Mean deviation from the comparison method (95 % C.I.) (%)	n	Outliers
Dept. BFG	Primary care A			
0,4—2,8	<2,5 in duplicate	—	20	0
3,0--120	14,6 (2,7—83)	-0,9 (-7,3—5,4)	20	0
	Primary care B			
0—2,6	<2,5 in duplicate	—	16	0
3,1—100,7	21,0 (3,3—94)	-7,4 (-12,9—(-1,9))	24	1

The demands to mean deviation (<10%) is fulfilled for *i*-CHROMA after the recalibration.

Figure 5.

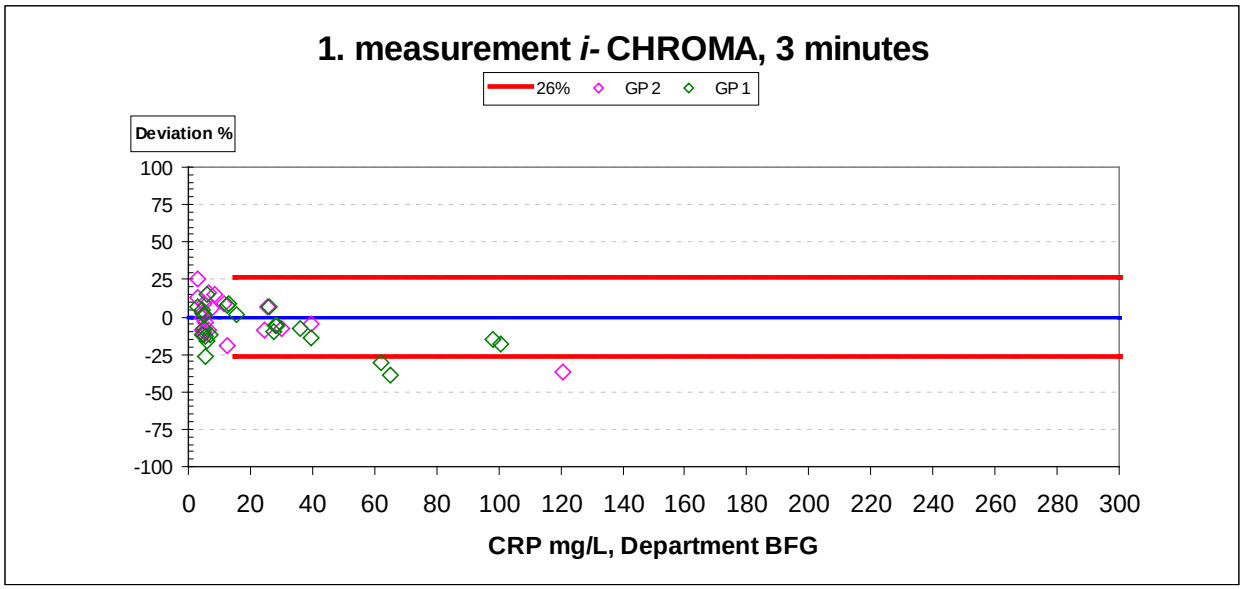

Figure 5. Accuracy for CRP with *i*-CHROMA in capillary samples in two primary care centres. Measuring time 3 minutes. The x-axis shows the mean value of the comparison method. The y-axis shows the deviation of the first measurement on *i*-CHROMA from the mean value of the duplicate results with the comparison method, n = 80. 77 of 80 (96,3%) results fulfil the demands.

5.5. Evaluation of user-friendliness

5.5.1. *Evaluation of the user-friendliness by laboratory-educated personal in a hospital laboratory*

Table 17.

Information in manual / insert about:	0 point	1 point	2 point
Well-presented, easy-to-grasp	Un-satisfactory	Less satisfactory	Satisfactory
Specimen collection	Un-satisfactory	Less satisfactory	Satisfactory
Preparations / Pre-analytic/test procedure	Un-satisfactory	Less satisfactory	Satisfactory
Measurement / reading	Un-satisfactory	Less satisfactory	Satisfactory
Measurement principle	Un-satisfactory	Less satisfactory	Satisfactory
Sources of error	Un-satisfactory	Less satisfactory	Satisfactory
Fault-tracing/Troubleshooting	Un-satisfactory	Less satisfactory	Satisfactory
Index	Un-satisfactory	Less satisfactory	Satisfactory
Readability / clarity of presentation	Un-satisfactory	Less satisfactory	Satisfactory
Available insert in Danish, Norwegian, Swedish	Un-satisfactory	Less satisfactory	Satisfactory
Rating for information in manual			Satisfactory

The manual is only available in Norwegian and English

Time factors	0 point	1 point	2 point
Preparations / Pre-analytical time	>10 min	6 to 10 min.	≤6 min.
Analytic time	>20 min	10 to 20 min.	≤10 min.
Demands to training	days	>2 hours	0 — 2 hours
Stability of test, unopened, (no/package)	≤3 months	>3 — 5 months	>6 months
Storage conditions of tests, unopened	–20 °C	2 — 8 °C	15 — 30 °C
Rating of time factors			Satisfactory

The expiry time for the Detection buffer when stored in room temperature is not specified in the manual.
One has to take the *i*-CHROMA reagents out of the refrigerator at least 10 minutes before use to let them reach room temperature.

Quality Control	0 point	1 point	2 point
Internal quality control	Un-satisfactory	Less satisfactory	Satisfactory
External quality control	Un-satisfactory	Less satisfactory	Satisfactory
Stability of quality control material	≤3 months	>3 — 5 months	>6 months
Storage conditions of control material	-20^0C	2 — 8°C	15 — 30°C
Interpretation of the Quality Control	Un-satisfactory	Less satisfactory	Satisfactory
Rating of quality control			Satisfactory

Instructions, for how to keep the control materials after dissolving them, are not specified in the manual.

Operation facility	0 point	1 point	2 point
To prepare the test / instrument	Un-satisfactory	Less satisfactory	Satisfactory
To prepare the sample *	Un-satisfactory	Less satisfactory	Satisfactory
Application of specimen	Un-satisfactory	Less satisfactory	Satisfactory
Specimen volume	Un-satisfactory	Less satisfactory	Satisfactory
Number of procedure step	Un-satisfactory	Less satisfactory	Satisfactory
Interpretation of the test	Very difficult	Difficult	Easy
Sources of errors	Un-satisfactory	Less satisfactory	Satisfactory
Cleaning/maintenance	Un-satisfactory	Less satisfactory	Satisfactory
Hygiene, when using the test	Un-satisfactory	Less satisfactory	Satisfactory
Environmental requirements, waste handling	Poison	Special arrangement	Biohazard
Educational requirements	Lab. technologist	Course	GP personal
Size and weight of package	Un-satisfactory	Less satisfactory	Satisfactory
Rating of operation			Satisfactory

Comments: * A possible source of error is incorrect sample volume. It is difficult to avoid sample on the outside of the capillary tube. When the excess sample is wiped off, there is a risk that some of the sample volume from inside the tube is also is removed.

5.5.2. *Evaluation of the user-friendliness by users in primary health care*
Both primary health care centres found the manual, the time factors, the quality assurance and the operation facility satisfactory. The results in primary care demonstrate, that sample material on

the outside of the capillary tube was not an source of error. When the excess sample is wiped off, there is a risk that some of the sample volume from inside the tube is also is removed.

Comments:
Centre A:
They new buffer tubes are clearly the best.
The buffer has to be stored in the refrigerator. It would be convenient if it could be kept at room temperature for some hours.
Pleasant to be able to do the analysing in one step.

Centre B:
Easy to handle.
It is positive that the whole procedure is made in one step
'Noisy' at the end of the test. The lid for the reagent was not handy in the first lot; It had been improved in the new lot (wdk4a05)

6. References

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7. Attachments

Attachment A Evaluations under the direction of SKUP

Summaries and complete reports from the evaluations are found at www.skup.nu

Evaluations performed in 2004 – 2007

Evaluation no.	Component	Instrument/testkit	Producer
SKUP/2008/69	Strep A	Diaquick Strep A test	Dialab GmbH
SKUP/2008/65	HbA1c	Afinion HbA1c	Axis-Shield PoC AS
SKUP/2007/64	Glucose[1]	FreeStyle Lite	Abbott Laboratories
SKUP/2007/62*	Strep A	*Confidential*	
SKUP/2008/61	CRP	*i*-CHROMA	BodiTech Med. Inc.
SKUP/2007/60	Glucose[1]	*Confidential*	
SKUP/2007/59	Glucose[1]	Ascensia BREEZE2	Bayer HealthCare
SKUP/2006/58	HbA1c	*Confidential*	
SKUP/2007/57*	PT (INR)	Simple Simon PT	Zafena AB
SKUP/2007/56*	PT (INR)	*Confidential*	
SKUP/2007/55	PT (INR)	CoaguChek XS	Roche Diagnostics
SKUP/2006/53*	Strep A	*Confidential*	
SKUP/2005/52*	Strep A	Clearview Exact Strep A Dipstick	Applied Biotech, Inc.
SKUP/2005/51*	Glucose[1]	FreeStyle	Abbott Laboratories
SKUP/2006/50	Glucose[1]	Glucocard X-Meter	Arkray, Inc.
SKUP/2006/49	Glucose[1]	Precision Xtra Plus	Abbott Laboratories
SKUP/2006/48	Glucose[1]	Accu-Chek Sensor	Roche Diagnostic
SKUP/2006/47	Haematology	Chempaq XBC	Chempaq
SKUP/2005/46*	PT (INR)	*Confidential*	
SKUP/2006/45	Glucose[1]	HemoCue Monitor	HemoCue AB
SKUP/2005/44	Glucose[1]	Accu-Chek Aviva	Roche Diagnostics
SKUP/2005/43	Glucose[1]	Accu-Chek Compact Plus	Roche Diagnostics
SKUP/2005/42*	Strep A	Twister Quick-Check Strep A	ACON laboratories, Inc.
SKUP/2006/41*	HbA1c	*Confidential*	
SKUP/2005/40	Glucose[1]	OneTouch GlucoTouch	LifeScan, Johnson & Johnson
SKUP/2005/39	Glucose[1]	OneTouch Ultra	LifeScan, Johnson & Johnson

*A report code followed by an asterisk, indicates that the evaluation for instance is a pre-marketing evaluation, and thereby confidential. A pre-marketing evaluation can result in a decision by the supplier not to launch the instrument onto the Scandinavian marked. If so, the evaluation remains confidential. The asterisk can also mark evaluations at special request from the supplier or evaluations that are not complete according to SKUP guidelines, e.g. the part performed by the intended users was not included in the protocol.

[1] Including a user-evaluation among diabetes patients.

Evaluations performed in 1999 – 2004

Evaluation no.	Component	Instrument/test kit	Producer
SKUP/2004/38*	Glucose	GlucoSure Plus	Apex Biotechnology Corp.
SKUP/2004/37*	u-hCG	Quick response u-hCG	Wondsfo Biotech
SKUP/2004/36*	Strep A	Dtec Strep A testcard	UltiMed
SKUP/2004/35*	u-hCG	QuickVue u-hCG	Quidel Corporation
SKUP/2004/34*	u-hCG	RapidVue u-hCG	Quidel Corporation
SKUP/2004/33	PT (INR)	Hemochron Jr. Signature	ITC International Technidyne
SKUP/2004/32*	Strep A	QuickVue In-Line Strep A test	Quidel Corporation
SKUP/2004/31*	PT (INR)	*Confidential*	
SKUP/2004/30	Glucose[1]	Ascensia Contour	Bayer Healthcare
SKUP/2004/29	Haemoglobin	Hemo_Control	EKF-diagnostic
SKUP/2003/28*	Strep A	QuickVue In-Line Strep A test	Quidel Corporation
SKUP/2003/27*	Strep A	QuickVue Dipstick Strep A test	Quidel Corporation
SKUP/2003/26*	HbA1c	*Confidential*	
SKUP/2003/25*	HbA1c	*Confidential*	
SKUP/2003/24*	Strep A	OSOM Strep A test	GenZyme, General Diag.
SKUP/2002/23*	Haematology with CRP	ABX Micros CRP	ABX Diagnostics
SKUP/2002/22	Glucose[1]	GlucoMen Glycó	Menarini Diagnostics
SKUP/2002/21	Glucose[1]	FreeStyle	TheraSense Inc.
SKUP/2002/20	Glucose	HemoCue 201	HemoCue AB
SKUP/2002/19*	PT(INR)	Reagents and calibrators	
SKUP/2002/18	Urine–Albumin	HemoCue	HemoCue AB
SKUP/2001/17	Haemoglobin	Biotest Hb	Biotest Medizin-technik GmbH
SKUP/2001/16*	Urine test strip	Aution Sticks and PocketChem UA	Arkray Factory Inc.
SKUP/2001/15*	Glucose	GlucoSure	Apex Biotechnology Corp.
SKUP/2001/14	Glucose	Precision Xtra	Medisense
SKUP/2001/13	SR	Microsed SR-system	ELECTA-LAB
SKUP/2001/12	CRP	QuikRead CRP	Orion
SKUP/2000/11	PT(INR)	ProTime	ITC International Technidyne Corp
SKUP/2000/10	PT(INR)	AvoSure PT	Avocet Medical Inc.
SKUP/2000/9	PT(INR)	Rapidpoint Coag	
SKUP/2000/8*	PT(INR)	Thrombotest/Thrombotrack	Axis-Shield
SKUP/2000/7	PT(INR)	CoaguChek S	Roche Diagnostics
SKUP/2000/6	Haematology	Sysmex KX-21	Sysmex Medical Electronics Co
SKUP/2000/5	Glucose	Accu-Chek Plus	Roche Diagnostics
SKUP/1999/4	HbA1c	DCA 2000	Bayer
SKUP/1999/3	HbA1c	NycoCard HbA1c	Axis-Shield PoC AS
SKUP/1999/2*	Glucose	Precision QID/Precision Plus Electrode, whole blood calibration	Medisense
SKUP/1999/1	Glucose	Precision G/Precision Plus Electrode, plasma calibration	Medisense

* A report code followed by an asterisk, indicates that the evaluation for instance is a pre-marketing evaluation, and thereby confidential. A pre-marketing evaluation can result in a decision by the supplier not to launch the instrument onto the Scandinavian marked. If so, the evaluation remains confidential. The asterisk can also mark evaluations at special request from the supplier or evaluations that are not complete according to SKUP guidelines, e.g. the part performed by the intended users was not included in the protocol.

[1] Including a user-evaluation among diabetes patients.

Grey area – The instrument is not in the market any more.

Attachment B Raw data

Attachments with raw data are included only in the report to Medic

Raw data

Low, medium and High Pools from patients

Control I-croma	Low I-croma	Modular	Modular
4,3	4,1	4	3,9
4,6	4,8	4,3	4,4
5	4,8	4,3	4,1
4,4	4,3	4	4,2
4,4	4,1	4,2	4,1
4,7	4,2	4,1	4,1
4,5	4,2	3,9	4
4,4	4,3	4,2	4,2
4,5	4,3	4	3,8
4,1	4,2	3,8	3,9
4,4	4,4	4,1	3,9
3,9	4,2	3,9	4,1
4,5	4,3	4,1	4,1
5,5	5,1	3,8	3,8
5,1	4,1	3,7	3,7
4,3	4,7	3,8	3,8
4,6	4,3	3,9	4,2
5,1	4,9	4	4
4,2	4,8	4,5	4,2
4,9	4,5	3,8	3,9
5	4,9	4,2	4
4,8	4,9	4,3	4
4,7	4,1	3,9	4
4,8	5	5,4	5,3

Control I-croma	Medium I-croma	Modular	Modular
19,7	19,5	18,9	18,3
18,3	20,2	19,2	18,2
19,5	18,2	19,4	18,9
18,6	19,4	18,6	18,9
19	20,6	18,8	18,4
20,3	18,1	18,7	18,9
19,7	17,5	17,5	17,8
20,7	20,5	18,8	18,7
20,2	18,5	17,9	17,8
18,4	15,7	18,3	17,5
19,4	18,2	18,4	18
18,6	20,6	18	18,1
19,6	20,2	18,4	18,4
19,9	19,3	18,2	18,2
19	19,6	17,5	17,6
20	19,8	17,7	18,1
19,7	20,1	18,1	18,3
20,9	18,8	17,3	17,5
20	19,9	17,5	17,5
20,4	20,8	17,3	17,3
20,3	20,2	18,2	18,1
17,1	19,1	17,7	17,7
19,8	20,5	17,9	17,7
19,2	20	19,6	21,7

Control I-croma	High I-croma	Modular	Modular
167,8	191	185,2	185,6
197,1	169,9	175,2	176,1
202,1	157,6	175,5	173,9
205,4	208,7	188,8	188,1
167,2	212,5	185,3	184,9
163,8	210,9	185	186,4
199,3	208,2	181	182,7
174,4	179	185,4	182,7
179,6	168,5	180,2	182,7
210,6	172	184,1	185,2
228,2	198,8	184,1	183,6
175,1	205,3	180,9	181,1
220,2	220,3	182,4	181,8
195,8	157,1	178,6	179,4
218,7	166,8	184,6	182,4
191,5	242,2	188,3	186,6
215,7	187,8	187,5	186,1
150,8	241,4	185,1	182,6
161,3	162,2	179,7	180,4
186,2	163,4	188,6	187,1
203	206	189,3	189,3
163,2	173,2	181	179,6
199,4	194,8	190	191,9

Attachment C Evaluation November 2006

A) Results from the evaluation in November 2006

	15 microl. EDTA-blod (vitrex) Samme fortynding målt 10 gange. CRP-Modular: 4,8 mg/l		15 microl. EDTA-blod (vitrex) Samme fortynding målt 10 gange. CRP-Modular: 56 mg/l	
1	3,2	kl.13,04	53,2	kl.11,10
2	3,5		58,3	
3	2,6		53,8	
4	2,6		52,1	
5	3,4		51,3	
6	2,9		49,8	
7	2,7		48,9	kl.11,44
8	<2,5		40,4	kl.12,21
9	2,5		40,7	
10	<2,5	kl.13,55	38	kl.12,33

middel	2,925	48,65
SD	0,366572	6,366671
CV%	12,53237	13,08668

middel	3,06	53,74
std	0,387814	2,438524
CV%	12,67367	4,537633

It seems that *i*-CHROMA is very time dependent

Attachment D November 2006

B) Results from the evaluation in November 2006

Stability of Pipette belonging to *i*-CHROMA

10 gange samme spids			10 gange ny spids
	Antal gram		Antal gram
	0,0752		0,0745
	0,0743		0,0749
	0,0756		0,0745
	0,0754		0,0752
	0,0752		0,075
	0,0757		0,0748
	0,0755		0,075
	0,075		0,0748
	0,0751		0,0751
	0,0749		0,0745
x middel:	0,0752	x middel:	0,0748
middel	0,07519		0,07483
median	0,0752		0,07485
sd	0,000386		0,000245
CV%	0,513201		0,327613

The pipette of the kit is OK

Attachment E Technical specifications

Technical specifications *i*-CHROMA™ Reader[4] from MEDIC

Physical Description

- Dimensions 250 (L) x 185 (W) x 80 (H) mm
- Weight 2 kg
- Power supply 100-240V AC, 50/60Hz, 0.5-1.3A
- Data output: On-board screen / Printer

Environmental Set-up

- Temperature 15oC ~30oC
- Humidity 10 ~ 80%
- Location Dry, clean, flat, horizontal surface away from direct sunlight and mechanical vibration.

Optical Description

- Light source Laser diode, 2.5 mW, 637nm
- Detector Silicon photo diode

Other

- Driver Motor 12V
- Interface RS-232 serial (I/O) port
- Printer Thermal
- Display LCD (16x4 character)
- Key pad 5 function keys

Technical specification for CRP cassette

Physical Description

[4] This device meets the EMI guideline as per EN60601-1-2.

- Dimensions 90 (L) x 11 (W) x 5 (H) mm
- Weight 4.8 g
- Color white

Environmental Set-up

- Temperature 20°C ~30°C (operating)
  4°C ~30°C (storage)
- Humidity 20 ~ 60% (operating)
  10 ~ 80% (storage)
- Location Dry, clean, flat, horizontal surface away from direct sunlight and mechanical vibration.

Technical specification for printer

Printing Method	Themal Line Printing	
Size(W * L * H)	100 X 191 X 90 mm	
Dot Density	200 X 200 DPI(8 dot/mm)	
Printing Width	48 mm	
Paper Width	58 mm	
Characters per line	32(Font A) (12X24), 42(Font B)(9X24)	
Printing Speed	Approximately 1.97 inchs /sec 50 mm/sec At 25 °C / Printing duty 12.5%	
Receive buffer size	15K bytes	
Supply Voltage	DC	24V 1.5A
Environmental Conditions	Temperature	0~40°C(operating) -10 ~ 50°C(storage)
	Humidity	30 ~ 80% RH(operating) 10 ~ 90% RH(storage)
MCBF	Mechanical	15,000,000 line
	Head	50 million pulse(about 50km)

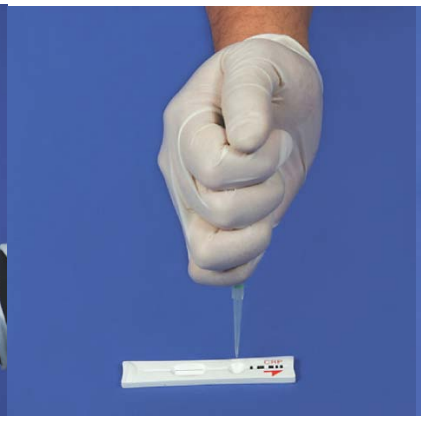
Attachment F The measuring procedure - Pictures from the manual

The step in measuring

15µl capillary blood in tube

the 15µl to the buffer solution

turn the buffer+capillary 5 times



The mixture (buffer+sample) is pipetted to the cassette which is placed in the I-Chroma instrument. The result is read after 3 minutes