General remarks

The evaluations of the results provided by the participating laboratories are summarised in a personal report which includes the laboratory performances for a given programme. Further information is available in the document entitled *Reports*. The statistical analyses used by the CSCQ for the evaluations are based on those described in the ISO 13528 document.

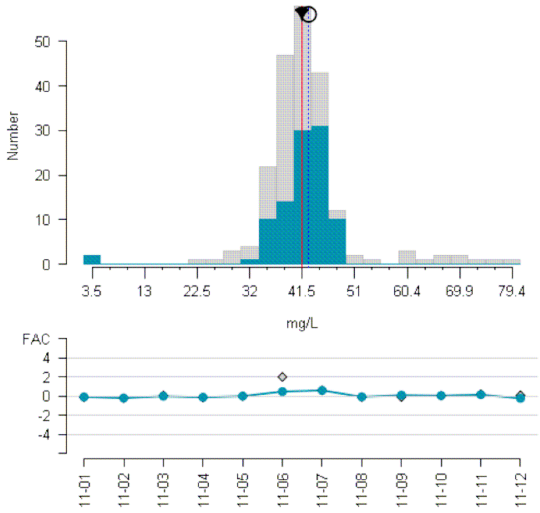
Statistical calculations for quantitative results – Basic formulae

Method target value	The method target value usually is a consensus value, the median of the results. The median is the 50th percentile (P50): 50% of the results are below, and 50% are above the target value. In some cases, calculating the method target value is not possible. This may happen for example when the number of results is too low (<7) or with a multimodal distribution.
Global target value	A global target value is provided for information purposes only. The calculation is the same as above, but is based on all the results obtained for a given parameter.
Standard deviation	The standard deviation quantifies the dispersion of the results. The following nonparametric formula is used for the calculation: $SD = \frac{P_{75} - P_{25}}{1.349}$, where ***P75*** and ***P25*** are the 75th and the 25th percentiles, respectively.
Coefficient of variation	The coefficient of variation is calculated as below: $CV = 100 \times \frac{SD}{m}$, where ***m*** is the median, and ***SD*** the standard deviation.
Standard uncertainty	The standard uncertainty of the target value is usually estimated with the following formula: $u = \sqrt{\frac{\Pi}{2}} SD / \sqrt{n}$, where ***SD*** is the standard deviation, and ***n*** the number of results. The uncertainty changes, from one survey to the other, according to the parameter, the result spread, and the number of results.
QUALAB tolerance interval	The interval is calculated – with reference to the QUALAB tolerance percentage – on the target value: [target – QUALAB tolerance in % on the target; target + QUALAB tolerance in % on the target] The full formula takes into account the standard uncertainty (see page 2).
FAC evaluation	The performance factor FAC (value without unit) measures the difference between the result and the target value according to the CSCQ tolerance percentage. It does not depend on other laboratories' results. The formula for the calculation is as follows: $FAC = \frac{r - v}{T}$, where ***r*** is the result provided by the laboratory, ***v*** the target value, and ***T*** the product of the target value and the CSCQ tolerance in %. The full formula includes the standard uncertainty. A qualitative assessment (see page 3) corresponds to each FAC value.
Z-score	The Z-score (value without unit) tells how far the laboratory result is from the target value. This laboratory performance indicator depends on other laboratories' results, and therefore on the result spread. It is calculated with the following formula (ISO/CEI 43-1:1997 standard): $z = \frac{r - v}{SD}$, where ***r*** is the result provided by the laboratory, ***v*** the target value, and ***SD*** the standard deviation. A negative Z-score means that the result is below the target value while a positive Z-score indicates that the result is above the target value.

Calculation examples with the complete formulae

The following graph and table summarize the statistical evaluation of a result (S-Protein, C reactive or S-CRP). Formulae and calculations are detailed below.

S-Protein, C reactive [700]



Your results :

Instrument :	Cobas 6000	
Result :	41.4 mg/L	
QUALAB assessment :	Satisfactory	
QUALAB Interval :	[33-53] (21%)	
FAC value :	-0.24 (Excellent)	0.08
Z-Score :	-0.32	0.09
Method	TurbColNep [308]	all
Participants :	98	208
Target value :	43 mg/L	41 mg/L
Uncertainty :	0.5 mg/L	
SD :	4.02 mg/L	4.45 mg/L
CV :	9.42 %	10.85 %

QUALAB tolerance interval, for the parameters for which EQA is mandatory

QUALAB interval = [$\boldsymbol{ltinf_{QUALAB}}$, $\boldsymbol{ltsup_{QUALAB}}$]

$\boldsymbol{ltinf_{QUALAB} = (v-u) \times (1-ptinf_{QUALAB})}$, where ***v*** is the target value, ***u*** the standard uncertainty, and $\boldsymbol{ptinf_{QUALAB}}$ the QUALAB lower percentage of tolerance expressed between 0 and 1.

$\boldsymbol{ltsup_{QUALAB} = (v+u) \times (1+ptsup_{QUALAB})}$, where ***v*** is the target value, ***u*** the standard uncertainty, and $\boldsymbol{ptsup_{QUALAB}}$ is the QUALAB upper percentage of tolerance expressed between 0 and 1.

The report only takes into account the significant figures of the QUALAB tolerance interval. The QUALAB tolerance percentages are listed in the parameter tables for each programme document ("QUALAB evaluation – Quality criterion" column).

The calculation of the QUALAB tolerance interval takes into account the following:

1. the unrounded target value, obtained from the results of participants using the same method as yours. S-CRP, method code 308, 98 returned results, target value v = 42.705 mg/L or 43 mg/L when considering the significant figures for this parameter,
2. the standard uncertainty of the target value. For this survey, this parameter, and this method, the estimated standard uncertainty is 0.509 mg/L,
3. the QUALAB tolerance percentage for this parameter (S-CRP), which is 21%
   lower tolerance ($\boldsymbol{ptinf_{QUALAB}}$) = upper tolerance ($\boldsymbol{ptsup_{QUALAB}}$) = 0.21

   The **QUALAB tolerance interval** is as under:

   QUALAB interval = [(42.705 – 0.509) x (1 – 0.21) ; (42.705 + 0.509) x (1+ 0.21)] = [33.334 ; 52.289]
   = [33 ; 53], when taking into account the significant figures only

CSCQ tolerance interval

CSCQ interval = [$\boldsymbol{ltinf_{CSCQ}}$, $\boldsymbol{ltsup_{CSCQ}}$]

$\boldsymbol{ltinf_{CSCQ} = (v-u) \times (1-ptinf_{CSCQ})}$, where ***v*** is the target value, ***u*** the standard uncertainty, and $\boldsymbol{ptinf_{CSCQ}}$ the CSCQ lower percentage of tolerance expressed between 0 and 1.

$\boldsymbol{ltsup_{CSCQ} = (v+u) \times (1+ptsup_{CSCQ})}$, where ***v*** is the target value, ***u*** the standard uncertainty, and $\boldsymbol{ptsup_{CSCQ}}$ the CSCQ upper percentage of tolerance expressed between 0 and 1.

The report only takes into account the significant figures of the CSCQ tolerance interval. The CSCQ tolerance percentages are listed in the parameter tables for each programme ("CSCQ tolerance" column). They were agreed upon by a group of experts involved in the specific corresponding scientific Societies in view of both clinical usefulness and analytical performance. They allow to define an interval on each side of the target value, in which a result is considered as acceptable. The CSCQ tolerances are updated, particularly to comply with new QUALAB tolerances. They are used to calculate the performance factors FAC.

Performance factor (FAC)

FAC = 2 x (***r*** - ***v***) / [$\boldsymbol{ltsup_{CSCQ} - ltinf_{CSCQ}}$], where ***r*** is the laboratory result, ***v*** the target value, and $\boldsymbol{ltinf_{CSCQ}}$ and $\boldsymbol{ltsup_{CSCQ}}$ are the CSCQ tolerance interval limits.

A negative FAC indicates that the measured value is below the target value, whereas a positive FAC indicates that the measured value is above the target value. The FAC can reach very high absolute values. For graphical scale reasons, when a value is > 5 (< -5 respectively), then the value is arbitrarily fixed at 5 (-5 respectively).

To the numerical values of the FAC are associated qualitative evaluations as follows:

FAC evaluation	FAC value	FAC evaluation	FAC value
Excellent	0 < FAC ≤ + 0.5	Below average	+ 2 < FAC ≤ + 3
Very good	+ 0.5 < FAC ≤ + 1	Poor	+ 3 < FAC ≤ + 4
Average	+ 1 < FAC ≤ + 2	Very poor	FAC > + 4

Negative values are classified in the same manner

The FAC calculation takes into account the following:

1. the unrounded target value, obtained from the results of participants using the same method as yours. S-CRP, method code 308, 98 returned results, target value v = 42.705 mg/L or 43 mg/L when considering the significant figures for this parameter,
2. the standard uncertainty of the target value. For this survey, this parameter, and this method, the estimated standard uncertainty is 0.509 mg/L,
3. the CSCQ tolerance percentage for this parameter, i.e. 11% for the S-CRP.
   lower tolerance ($\boldsymbol{ptinf_{CSCQ}}$) = upper tolerance ($\boldsymbol{ptsup_{CSCQ}}$) = 0.11.

   With the above described formula, the **CSCQ tolerance interval** is as under:

   CSCQ interval = [$\boldsymbol{ltinf_{CSCQ}}$, $\boldsymbol{ltsup_{CSCQ}}$]
   = [(42.705 – 0.509) x (1 – 0.11) ; (42.705 + 0.509) x (1+ 0.11)] = [37.554 ; 47.967]
   = [37 ; 48] when taking into account the significant figures only

   FAC = 2 x (41.4 – 42.705) / [***48 - 37***] = -0.2372

   FAC = -0.24 which corresponds to an "excellent" evaluation in the above table.

Integrating the standard uncertainty in the calculation of tolerance intervals makes the calculation of precise FAC values difficult for the participant. Upon request, the CSCQ can send the precise uncertainty value obtained for a given parameter and survey.

The same formula is used for the FAC calculation, taking into account the results obtained with all the methods (the unique difference is that the standard uncertainty of the global target value is not considered). It is calculated with the global, unrounded target value (Method, all), i.e. 41 mg/L in the following example:

CSCQ interval = [41 x (1 – 0.11) ; 41 x (1+ 0.11)] = [36.49 ; 45.51]
= [36 ; 46], when taking into account the significant figures only

FAC = 2 x (41.4 - 41) / [***46 - 36***] = 0.08

Qualitative and semi-quantitative result evaluations

1. When the result cannot be anything but either positive or negative (in Strep A and drug of abuse EQA programmes, etc.), the evaluations are as follows:

Target	Result	QUALAB evaluation	FAC evaluation	FAC value
Positive	Positive	Satisfactory	Excellent	0
	Negative	Not satisfactory	Very poor	- 4.1
Negative	Negative	Satisfactory	Excellent	0
	Positive	Not satisfactory	Very poor	4.1

2. When the result is a semi-quantitative value (pH with urine test strips for example) or a result range (0 - 10, 10 - 25, 25 - 50, 50 - 100, >100 mg/L for example), the evaluations are as follows:

Target	Result	QUALAB evaluation	FAC evaluation	FAC value
Range r	Range r	Satisfactory	Excellent	0
	Range r ± 1 range	Satisfactory	Very good	- 0.75 or + 0.75
	Range r ± >1 range	Not satisfactory	Very poor	- 4.1 or + 4.1

3. In some situations (such as microbiology), several results are acceptable. The performance evaluation is based on reference strains and on experts' conclusions. The classification is the following:

FAC evaluation	FAC value
Excellent	0
Very good	0.75
Average	1.1
Below average	2.1
Poor	3.1
Very poor	4.1

P e r s o n a l n o t e s