Different Approaches to Determination of the Reference Value and Degrees of Equivalence in Key Comparisons

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The report deals with the analyses of requirements for a valid application of statistical methods used to treat measurement data of key comparisons. With the aim to clarify a specific character of the key comparisons data, they are compared with the data of an interlaboratory experiment when the latter is carried out for certification of a measure or a measurement procedure. Different approaches for determination and interpretation of the reference value and the degrees of equivalence are considered, i.e.:

1. The reference value is determined independently of the data of key comparisons. It is the most precise estimate of the measurand whose accuracy is significantly higher than accuracy of measurement results obtained at participating laboratories.

2. The reference value is determined from the measurement results obtained at participating laboratories. Different interpretation of the reference value will be considered.

3. The reference value is just a way for representing the data of key comparisons.

From the analysis performed, the following conclusions were reached:

1. An algorithm for calculating the reference value should be simple and robust. Application of optimal algorithms based upon strict models, whose adequacy either is difficult to be verified or they are not realized in practice, leads to incorrect conclusions. In this case the discrimination of some laboratories is possible. Application of the median as the reference value appears to be the most justified from the different points of view

2. The equivalence of measurement standards in its broadest sense means the equivalence of measurements carried out in laboratories of NMIs. In this   connection reproducibility of measurements performed in different laboratories seems to be the most suitable interpretation of the concept "equivalence". The degree of equivalence is a quantitative measure of equivalence allowing describing the reproducibility of measurements done in the given laboratory with respect to a group of participating laboratories. Deviations from the reference value characterize a systematic bias in results obtained in the given laboratory in respect to all other laboratories while the uncertainty of this deviation characterizes the reproducibility of measurement results within the given laboratory.

3. At the stage, at which a procedure for carrying out key comparisons is developed, it is necessary to provide equal conditions to all laboratories. The degree of concretization and detailing of a description of the measurement procedure depends upon a specific kind of measurements, but it's quite evident that measurement conditions, influencing factors, sources of uncertainties, a number of measurements – all these should be explicitly stated when the key comparisons are being planned. In those cases where the measurand is not determined unambiguously and various interpretation of measurement conditions are possible, the measurement procedure and the way of data presentation should be coordinated in details. Otherwise, comparison of measurement data meet difficulties.

4. Analysis of the data obtained is an important stage of key comparisons. Determination of the degree of equivalence is, in a sense, an expression of existing situation in reproduction of measurement results in various NMIs. However, the comparisons data carry unique information that can be used for further research work aimed at increasing accuracy of measurements, revealing additional sources of uncertainty, improving measurement standards and methods for carrying out measurements, as well as at planning of further comparisons.