Upsala J Med Sci 95: 173–183, 1990

The NORDKEM Project and Its Aims

Carl-Henric de Verdier

Department of Clinical Chemistry, University of Uppsala, Uppsala, Sweden

BACKGROUND

The NORDKEM project on "Medical Need for Quality Specifications in Laboratory Medicine" originates from two earlier NORDKEM projects and from "General Scandinavian recommendations on quality control and quality assurance in clinical chemistry" prepared by an earlier "Nordic Committee on Quality Control" and approved by the Board of the Scandinavian Society for Clinical Chemistry in March 1989 (22).

The first NORDKEM project - "Assessing Quality Requirements in Clinical Chemistry" - was running between 1977 - 1980 (3) and described the general problems and how the quality requirements for some specified clinical situations could be estimated.
The second project - "Quality Control in Clinical Chemistry - Efforts to Find an Efficient Strategy" - was running between 1979 - 1984 (4). The report contained procedures for internal quality control and external quality assurance[1], effects of using different control materials, brief accounts of the different Nordic national programs, descriptions of "tools" for improved achievements and quality-cost evaluations. The report ended up in tentative recommendations for analytical quality control/assurance programs. These have been under discussion in the national Nordic societies for clinical chemistry (8) and were after slight modifications finally published as the General Scandinavian recommendations mentioned above. These recommendations include new ideas as laboratory quality specifications presented openly to the customers of the laboratory and widening

[1]The term external quality assurance is preferred to the term external quality assessment (recommended by WHO and ECCLS) as the programs intend not only to account for quality but also "to provide adequate confidence" in the analytical results of the laboratories.

the concept of quality assurance to include more than analytical quality e. g. turnaround time and cost-benefit.

PROJECT ORGANIZATION

The earlier Nordic committee on quality control sent an application to the Board of NORDKEM for a project on quality goals and quality specifications in clinical chemistry and a small support for further planning was granted in November 1988. A project group was formed with participation from the four major Nordic countries:

Per Hyltoft Petersen, Odense University, Denmark
Aimo Ruokonen, Oulu University, Finland
Per Kristian Lund, Fürst Laboratory, Oslo, Norway
Torsten Aronsson, Uppsala University, Sweden
Torgny Groth, Uppsala University, Sweden
Carl-Henric de Verdier, Uppsala University, Sweden
Arno Nyberg, NORDKEM, Helsinki, Finland

The objectives of the project were to:

* Help Nordic clinical chemistry laboratories to - originating from "clinical goals" and knowledge of available resources - define the "Laboratory Quality Specifications" and implement them in the laboratories.
* Investigate the sensitivity of the laboratory quality specifications for economical constraints.

The final project plan was accepted by NORDKEM in June 1989 and according to this plan the project was divided into the following five phases:

* The planning phase
* Seminar with invited foreign experts. Discussion of aims and plan for the project. April 23-24 1990. Friiberghs Herrgård, Bro, Uppland, Sweden.
* Project work within four main areas and invitation to interested clinical chemists to participate in a number of associated projects.
* Meeting with report and discussion of results. Planned for May 1992. Preparation of a printed report.

the concept of quality assurance to include more than analytical quality **e. g.** turnaround time and cost-benefit.

PROJECT ORGANIZATION

The earlier Nordic committee on quality control sent an application to the Board of NORDKEM for a project on quality goals and quality specifications in clinical chemistry and a small support for further planning was granted in November 1988. A project group was formed with participation from the four major Nordic countries:

Per Hyltoft Petersen, Odense University, Denmark
Aimo Ruokonen, Oulu University, Finland
Per Kristian Lund, Fürst Laboratory, Oslo, Norway
Torsten Aronsson, Uppsala University, Sweden
Torgny Groth, Uppsala University, Sweden
Carl-Henric de Verdier, Uppsala University, Sweden
Arno Nyberg, NORDKEM, Helsinki, Finland

The objectives of the project were to:

* Help Nordic clinical chemistry laboratories to - originating from "clinical goals" and knowledge of available resources - define the "Laboratory Quality Specifications" and implement them in the laboratories.
* Investigate the sensitivity of the laboratory quality specifications for economical constraints.

The final project plan was accepted by NORDKEM in June 1989 and according to this plan the project was divided into the following five phases:

* The planning phase
* Seminar with invited foreign experts. Discussion of aims and plan for the project. April 23-24 1990. Friiberghs Herrgård, Bro, Uppland, Sweden.
* Project work within four main areas and invitation to interested clinical chemists to participate in a number of associated projects.
* Meeting with report and discussion of results. Planned for May 1992. Preparation of a printed report.

* Information about methodology for defining "clinical quality goals" and "laboratory quality specifications" and the implications of the new concepts. A session is planned at the XXIII Nordic Congress in Clinical Chemistry in August 1992 in Reykjavik, Iceland as well as a special course in connection with the congress. Phase 5 of the project is up till now not financially covered by NORDKEM.

THE PROJECTS

Two of the main projects - the plasma proteins (5,6) and the hormones (6) have their origin in quality assurance projects run within the earlier Nordic Committee on Quality Control. The third project - transferability of laboratory data - goes back to a regional interlaboratory quality assurance program (21) with attempts to create models for acceptable transfer of data. The object of the fourth main project is to accumulate experiences from the three main projects and a number of associated projects (see the summing up chapter of this report) and to condense these into a "Guideline" for the introduction of the two concepts "Clinical Quality Needs" and "Laboratory Quality Specifications" to the clinical laboratories.

DESCRIPTION OF TECHNIQUE

The terminology used in this project is explained in Fig. 1. Starting from the top the "Clinical Needs" have to be estimated for a number of clinical situations. Using the International Vocabulary of Basic and General Terms in Metrology (VIM) (32) and to some extent the "Glossary" of the final draft of the ECCLS Guidelines on "Good Practice in Decentralized Clinical Laboratories" (9) the clinical needs have to be expressed in terms of maximal allowable difference of values or as a coefficient of variation (CV). In both cases the concentration must be stated. The "Clinical Quality Specifications" containing similar information include also the components of variation introduced by insufficient standardization of the patient, the sampling and the handling of the patient's sample. It is important to be aware if the clinical decision will be dependent on local rules or regional, national or international professional recommendations or guidelines. In the latter cases it is important to include the

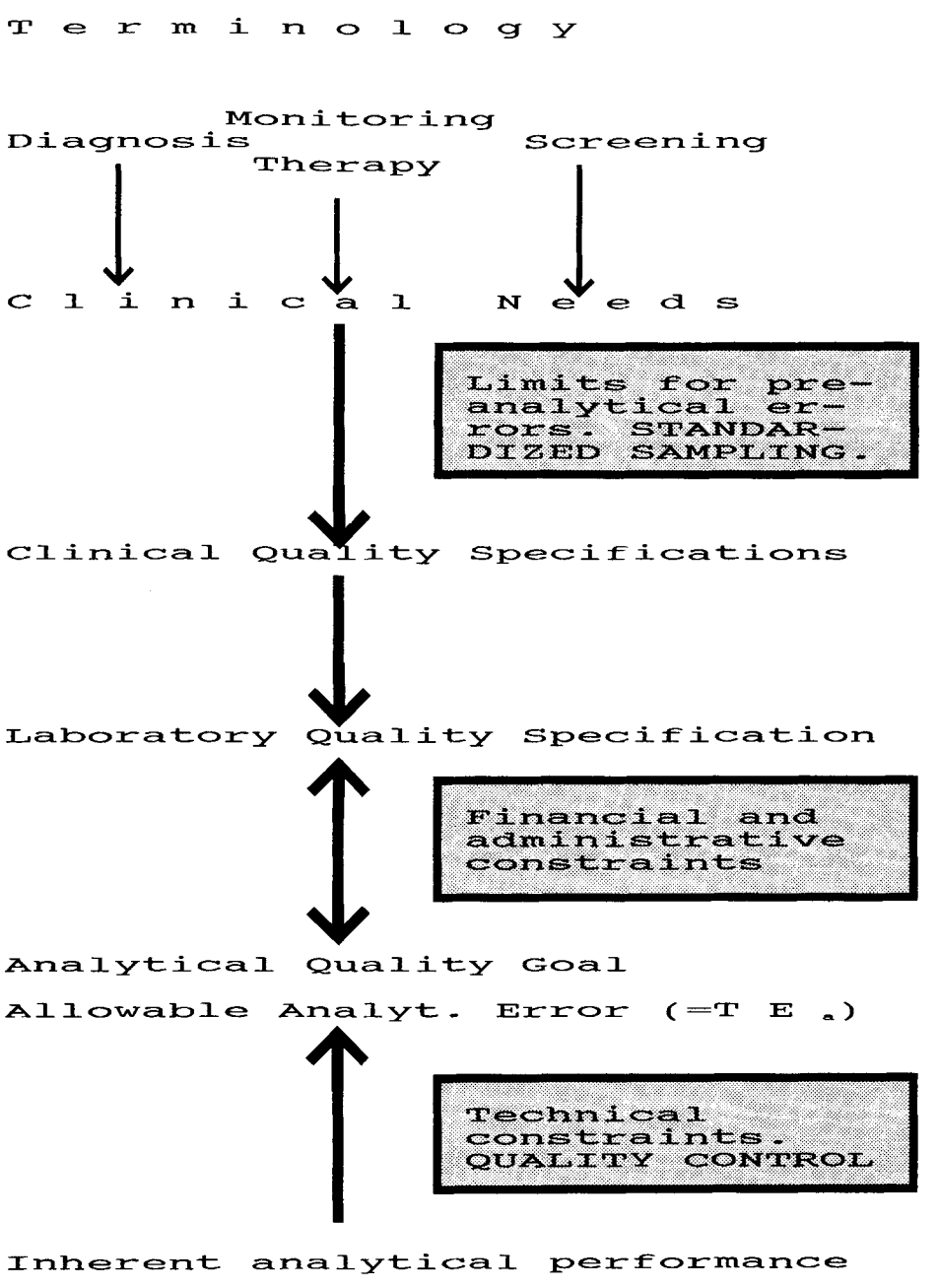

Fig. 1. Terminology for different concepts of quality specifications in clinical laboratories.

(longterm) bias of the laboratory, in the former case the bias of the laboratory is usually included in the estimations.
Starting from the **bottom** (the laboratory side) the inherent analytical performance is described by e.g. bias and inherent imprecision (s). The evaluation procedure during the introduction of the method in a major laboratory (and also at reevaluations later) and in multicentre studies and the process of designing the internal quality control system will provide estimates of bias, RE_c, SE_c, frequency of errors etc.
At the local level there may be financial or (local or central) administrative constraints that will prevent the laboratory from procuring the equipment and reagents that will provide an analytical system with the needed analytical quality. The resulting "Laboratory Quality Specifications" will always be a compromise between different interests but it is important that the laboratory is playing with open cards and inform their customers about the valid laboratory quality specifications that the laboratory is going to follow with a probability of e. g. 95 %.
The methodological approach. See Table 1.

Table 1.
Different methods to estimate the "Clinical Needs" and the "Laboratory Quality Specifications"

1. To look at distributions of values from a healthy population (the unimodal approach) (11,16,26)
2. To look at intraindividual variation for healthy individuals (14,15).
3. To look at distributions of values from a healthy and a well defined sick population (the bimodal approach) (13,20).
4. To look at decision algorithms at clinically used decision levels (24,31).
5. To look at knowledge bases without or fortified with biodynamic computer models (12,27).
6. To use experiences of expert groups and well trained surgeons and physicians (from hospitals and primary care) (17,29).
7. To ask specific questions and use experiences of well trained clinicians (23,25).
8. To assess e. g. CDC proposed (10,19) proficiency test (PT) limits.

Results from one analytical method can be used in different clinical situations with different needs for speedy handling and quality. Here in general the situations that has the highest priority will be the deciding one. For many clinical cases there will be many factors and circumstances that influence the outcome. Here it will be difficult to calculate the clinical need for quality. It must be remembered - at least in the beginning - that the quality specifications is provisional and should be reassessed periodically. New development both within the area of clinical laboratory analyses and the field of clinical diagnosis and treatment will call for rapid changes of the quality specifications.

It is necessary to be pragmatic in the work with quality specifications. It is thus not meaningful to investigate the medical effect of errors that are much lower than what is estimated in most laboratories today with the analytical equipments and the commercial reagents available on the market.

THE GOALS OF THE PROJECT

The project group has tried to formulate the goals of the project and also made an attempt to divide these goals into long and short term goals. The result of this exercise is presented in Table 2.

WHY QUALITY SPECIFICATIONS?

There is today a growing interest for quality in clinical work (7).Analytical quality is - compared with the quality of other areas of health care - easy to measure and the clinical chemists have therefore been working with quality problems for a comparatively long period of time. The logical way of approaching the problem is, however, to primarily estimate the "Clinical Need" and then to assess the methodology and to design the control program that will assure that the clinical needs will be fulfilled. It is only recently that practical attempts have started to be made to achieve such ambitions (18,29) and as a consequence define "Analytical Quality Goals" and "Laboratory Quality Specifications". There are several advantages of working along such lines as listed in Table 3.

Table 2.

Long and short term goals:

Long-term goals	**Short-term goals**
1. Guidelines for Quality Specifications	1. Organize NORDKEM seminar on Quality Specification and publish a report
2. Provide Nordic clinical chemical laboratories with background material for calculating "laboratory quality specifications" for their more common analyses	2. Carry out three basic projects within the areas: serum proteins, (low molecular serum hormones and transferability of data
3. Prepare a list with suggested "analytical quality goals" for for reported results for a selected number (20 - 30 ?) of common analyses	3. Stimulate similar work in affiliated project groups (within and outside Scandinavia)
4. Apply the specifications for design of internal and external control systems (18,28,30)	4. Digest the results. Suggest terminology. Suggest procedures. Compare and evaluate procedures

Table 3.

Arguments for Analytical Quality Goals and Laboratory Quality Specifications.

They are needed for

* Design of internal quality control (18,28,30)
* Organization of clinical chemistry within hospitals, hospital areas and hospital regions
* Discussions with the customers of the laboratory (clinical departments, primary care etc)
* Discussions with industrial manufacturers of analytical equipments and reagents
* Billing of analyses (in hospital laboratories and commercial laboratories performing clinical laboratory tests)
* Introductory attempts to transfer results between laboratories

3. In Hoerder M: (ed): Assessing Quality Requirements in Clinical Chemistry, Helsinki, NORDKEM, 1980, p 1-144.

4. In de Verdier C-H, Aronsson T, Nyberg A: (eds): Quality Control in Clinical Chemistry - Efforts to Find an Efficient Strategy, Helsinki, NORDKEM, 1984, p 1-241.

5. Bjoero K, Blaabjerg O, Icén A, Irjala K, Hyltoft Petersen P. The Nordic Protein project. Scand J Clin Lab Invest (1990);50 suppl 202:180-180.

6. Blaabjerg O, Carlström A, Hyltoft Petersen P, Lund PK, Ruokonen A. External quality assurance model for improvement of specificity and accuracy of serum hormone determinations in the Nordic countries. Scand J Clin Lab Invest (1988);48 suppl 190:155-155.

7. Blumenthal D, Laffel G. The case for using industrial quality management science in health care organizations. JAMA (1989);262: 2869-2873.

8. de Verdier C-H, Haabrekke O, Leskinen E, Uldall A. Editorial review. Quality assurance in clinical chemistry - time to go from theory into action. Scand J Clin Lab Invest (1986);46:393-396.

9. Dybkaer R, Martin DV, Rowan RM. Good practice in decentralized analytical clinical measurement. Scand J Clin Lab Invest (1991);51 suppl (in press).

10. Ehrmeyer SS, Laessig RH. Use of alternative rules (other than the 1 2s) for evaluating interlaboratory performance data. Clin Chem (1988);34:250-256.

11. Gowan EMS, Hyltoft Petersen P, Blaabjerg O, Hoerder M. Analytical goals for the acceptance of common reference intervals for laboratories throughout a geographical area. Scand J Clin Lab Invest (1988);48:757-764.

12. Groth T, Hakman M, Hällgren R, Roxin L-E, Venge P. Diagnosis,size estimation and prediction of acute myocardial infarction from S-myoglobin observations: A system analysis to assess the influence of various sources of variability. Scand J Clin Lab Invest (1980);40 Suppl 155:111-124.

13. Groth T, Ljunghall S, de Verdier C-H. Optimal screening for patients with hyperparathyroidism with use of serum calcium observations: A decision-theoretical analysis. Scand J Clin Lab Invest (1983);43:699-707.

14. Harris EK. Statistical principles underlying analytical goal-setting in clinical chemistry. Am J Clin Path (1979);72:374--382.
15. Harris EK. Proposed goals for analytical precision and accuracy in single-point testing: theoretical basis and comparison with data from the College of American pathologists proficiency surveys. Arch Pathol Lab Med (1988);118:416-420.
16. Hyltoft Petersen P, Gowans EMS, Blaabjerg O, Hoerder M. Analytical goals for the estimation of non-Gaussian reference intervals. Scand J Clin Lab Invest (1989);49:727-737.
17. Jacobson G, Groth T, de Verdier C-H. Pancreatic iso-amylase in serum as a diagnostic test in different clinical situations: A simulation study. Scand J Clin Lab Invest (1980);40 suppl 155:77-84.
18. Koch DD, Oryall JJ, Quam EF, et al. Selection of medically useful quality-control procedures for individual tests done in a multitest analytical system. Clin Chem (1990);36:230-233.
19. Laessig RH, Ehrmeyer SS. Use of computer modelling to predict magnitude of interlaboratory error tolerated by proposed CDC interlaboratory proficiency testing performance criteria. Clin Chem (1988);34:1849-1852.
20. Noerregaard-Hansen K, Hyltoft petersen P, Hangaard J, Simonsen EE, Rasmussen O, Hoerder M. Early observations of S-myoglobin in the diagnosis of acute myocardial infarction. The influence of discrimination limit, analytical quality , patient's sex and prevalence of disease. Scand J Clin Lab Invest (1986);46: 561-569.
21. Olafsdottir E, Aronsson T, Groth T, de Verdier C-H. Transferability of clinical laboratory data within a geographical region. (1991);(UnPub)
22. Scandinavian Society for Clinical Chemistry. General Scandinavian Recommendation on Quality Control an Quality Assurance in Clinical Chemistry. Scand J Clin Lab Invest (1990);50:225-227.
23. Skendzel LP, Barnett RN, Platt R. Medical useful criteria for analytical performance of laboratory tests. Am J Clin Path (1985);83:200-205.
24. Stewart MJ, Fraser CG. Desirable performance standards for assays of drugs. Ann Clin Biochem (1989);26:220-226.

25. Thue G, Sandberg S, Fugelli P. Clinical assessment of hemoglobin values by general practitioners related to analytical and biological variation. A study based on case stories. Scand J Clin Lab Invest (1990);50 suppl 202:225-225.
26. Tonks DB. A study of the accuracy and precision of clinical chemistry determinations in 170 Canadian laboratories. Clin Chem (1963);9:217-233.
27. Van Waeg G, Groth T, Niklasson F, de Verdier C-H. Allopurinol kinetics in humans as a means to assess liver function: comparison of different models. Am J Physiol (1987);253:352-360.
28. Westgard JO, Groth T, de Verdier C-H: Principles for developing improved quality control procedures, in de Verdier C-H, Aronsson T, Nyberg A: (eds): Quality control in clinical chemistry - Efforts to find an efficient strategy, Helsinki, NORDKEM, 1984, pp 19-41.
29. Westgard JO, Hyltoft Petersen P, Wiebe A. Laboratory Process Specifications for Assuring Quality in the U.S. National Cholesterol Education Pogram (NCEP). Clin Chem (1991);37 (in press).
30. Westgard JO, Quam EF, Barry PL. Quality control selection grids (QCSGs) for planning QC procedures. J Clin Lab Sci (1990);3:271-278.
31. Wiener F, de Verdier C-H, Groth T. The use of knowledge-based information system for interpreting specialized clinical chemistry analyses - experience from erythrocyte enzymes and metabolites. Scand J Clin Lab Invest (1990);50:247-259.
32. Zender R. Measurements in Biological Systems. Metrological Principles and Terminology. Scand J Clin Lab Invest (1989);49 suppl 193:3-10.

Correspondence:
Professor Carl-Henric de Verdier
Department of Clinical Chemistry, Uppsala University
Postal address: University Hospital
S-751 85 Uppsala, Sweden