

Accreditation of Medical Laboratories in Croatia – Experiences of the Institute of Clinical Chemistry, University Hospital »Mercur«, Zagreb

Zlata Flegar-Meštrić^{1,3}, Aida Nazor¹, Sonja Perkov¹, Branka Šurina¹, Mirjana Mariana Kardum-Paro¹, Zoran Šiftar¹, Mirjana Sikirica¹, Ivica Sokolić¹, Ivan Ožvald¹ and Željko Vidas²

¹ Institute of Clinical Chemistry, University Hospital »Mercur«, Zagreb, Croatia

² University Hospital »Mercur«, Zagreb, Croatia

³ University of Zagreb, Faculty of Pharmacy and Biochemistry, Zagreb, Croatia

ABSTRACT

Since 2003 when the international norm for implementation of quality management in medical laboratories (EN ISO 15189, Medical laboratories – Particular requirements for quality and competence) was established and accepted, accreditation has become practical, generally accepted method of quality management and confirmation of technical competence of medical laboratories in the whole world. This norm has been translated into Croatian and accepted by the Croatian Institute for Norms as Croatian norm. Accreditation is carried out on voluntary basis by the Croatian Accreditation Agency that has up to now accredited two clinical medical biochemical laboratories in the Republic of Croatia. Advantages of accredited laboratory lie in its documented management system, constant improvement and training, reliability of test results, establishing users' trust in laboratory services, test results comparability and interlaboratory (international) test results acceptance by adopting the concept of metrological traceability in laboratory medicine.

Key words: medical biochemical laboratory, ISO standards, accreditation, quality management, traceability in laboratory medicine, Croatia

Introduction

The Croatian health system is faced with numerous global changes which require more rational, efficient, and comprehensive medical care by application of health services based on scientific evidence and principles of the best professional practice and international quality standards in all areas of professional performance. The aim of the health policy of Croatian Ministry of Health is health protection and improvement with longer and better quality of life for population and individuals¹. It should be achieved by constant improvement of medical services and acceptance of international quality standards through certification and accreditation of health system. Today is quality management system in medical laboratories implemented by application of international norm EN ISO 15189, Medical laboratories – Particular requirements for quality and competence².

Quality Management Systems and Accreditation of Medical Biochemical Laboratories

In scope of laboratory medicine, medical biochemical laboratories as a part of the health system are continuously implementing measures to improve the quality of their performance, what has resulted in their full readiness for acceptance of quality management system according to international norms³.

Up to the establishment of the Croatian Chamber of Medical Biochemists (CCMB) in 1994 the quality of medical biochemical laboratories was assessed on the basis of internal quality control results and external quality assessment. The internal quality control shapes every laboratory depending on the fields of its performance, and accepting the recommendations from the International

Federation of Clinical Chemistry and Laboratory Medicine (IFCC), while the external quality assessment (EQA) of medical biochemical laboratories has been continuously carried through since 1973 by the Committee for External Quality Assessment as part of Croatian Society of Medical Biochemists (CSMB). The purpose of the national EQA scheme is to establish objectively the degree of inter-laboratory comparability and contribute through continuous education to improvement of laboratory medicine in Croatia^{4,5}. The scheme has several modules which include general medical biochemical tests (biochemistry, laboratory hematology, laboratory coagulation, qualitative urine analysis, urine sediment analysis) and a part of specialist laboratory tests (pH, blood gasses and ionised electrolytes analysis, tumor markers, thyroid hormones, hemoglobin A_{1c}) and is conducted three times a year. 2009 there will be 211 medical biochemical laboratories which will participate in the national EQA scheme.

By the decision of Croatian Chamber of Medical Biochemists the participation in the national EQA scheme is obligatory for all medical biochemical laboratories (The Law on Medical Biochemical Activity, Article 43, published in Official Gazette 121/2003). Therefore, the results of EQA⁶ are one of quality indicators in scope of professional supervision of the performance of medical biochemical laboratories.

External professional audit is carried out according to the »Rules on auditing of Medical Biochemical Laboratories and medical biochemists« (Official Gazette 8/2004) accepted according to the Article 49 of the Law on Medical Biochemical Activity« (Official Gazette 121/03) and Article 10 of the Statute of the Croatian Chamber of Medical Biochemists (CCMB). Supported financially by the state budget, it is carried out by the Committee for External Professional Audit of CCMB according to the instructions from the manual »Rules on auditing of Medical Biochemical Laboratories and medical biochemists« that has been in use since 2005. The procedure is carried out by the medical biochemistry specialists gradually educated and authorized by the Executive Board for these activities. In the first part there is the procedure of self-evaluation by a questionnaire that checks the results of internal quality control, EQA and compliance with professional standards, while in the second part the authorized assessor checks these data on site. Yearly report on conducted professional audit is submitted to the Croatian Ministry of Health and Social Care. Reporting on test results is made to the Health Inspection of the Ministry of Health and Social Care.

Since 2003, when the international norm for implementation of quality management system in medical biochemical laboratories was accepted and published (EN ISO 15189, Medical laboratories – Particular requirements for quality and competence), accreditation has become a practical and generally accepted method for quality management and confirmation of technical equipment of medical laboratories in the whole world. The term accreditation of medical laboratories involves laboratories for biological, microbiological, immunological,

chemical, immunohematological, hematological, biophysical, cytological, pathological or other tests of materials originating from the human body with the purpose of providing information for diagnosis, prevention and treatment of diseases or for health estimation. It can give counsels involving all aspects of laboratory testing, including result interpretation and counseling regarding further appropriate testing². Accreditation is specific for certain fields of laboratory diagnostics and it is directed to patient's care, results interpretation, monitoring of overall laboratory process and ethics in laboratory medicine. Laboratories must establish, carry out and maintain quality system suitable to the scope of their activities.

The norm includes 8 requirements related to management and 15 technical requirements which are to be fulfilled entirely by the applying laboratory. According to the requirements related to management (4.1 Organization and management, 4.2 Quality management system, 4.3 Document control) laboratory must clearly define its procedures, describe them in its documentation, introduce the personnel with defined procedures, make sure that the personnel understands and implements them, document the procedures and continuously work on system improvement. Management system documentation includes a set of documents (quality manual, procedures, working instructions, regulations, standards and other normative documents) which defines and describes the management system. For management and application of documentation for quality management system there has to be defined responsibilities and authorizations, distribution (controlled/uncontrolled documentation of quality management system) and reviewing/auditing of management system documents. All activities are required to be recorded written or electronically. Quality Manager supervises the compliance with requirements of quality management system.

Technical requirements and partly management requirements review all phases of laboratory process: pre-analytical and analytical phase (according to requirements: 5.4 Pre examination procedures, 5.5 Examination procedures, 5.6 Assuring quality of examination procedures) and post-analytical phase related to results reporting of laboratory analyses (requirements 5.7 Post examination procedures, 5.8 Reporting of results). Furthermore, the laboratory is also required to have a advisory role (requirement 4.7).

Internal audits have extreme importance not in sense of searching for errors, but as a way of finding new possibilities for improvements. This independent evaluation is carried out through vertical, horizontal or on site supervision. Vertical supervision provides an insight of the entire quality management system and includes following basic requirements: 4.3. Document control, 4.13 Quality and technical records, 5.1 Personnel, 5.2 Accommodation and environmental conditions, 5.3 Laboratory equipment, 4.6 External services and supplies, 5.6 Assuring quality of examination procedures.

Evaluation and analysis of quality management system and its continuous improvement (requirement 4.12)

are monitored at least by following requirements: 4.1 Organization and management, 4.4 Review of contracts, 4.13 Quality and technical records, 4.8 Resolution of complaints, 4.9 Identification and control of nonconformities, 5.6 Assuring quality of examination procedures. Corrective actions (requirement 4.10) are very important (requirement 4.10) whose goal is finding the cause of observed errors and improving that part of laboratory process. In the health system in relation to patient's safety laboratory errors are not committed so often, but that does not mean they should not to be prevented. Preventive actions (requirement 4.11) should keep errors from occurring. Those actions resemble the risk management procedure.

The greatest meaning bears the management review (requirement 4.15) that reviews the existing status, analyses implemented corrective actions and plans possible improvements regarding effectiveness and quality improvement of all phases of laboratory process. In order to successfully implement the management review it is necessary to define quality indicators that represent the measure for quality quantification of all laboratory processes. This approach provides goals of quality management system that should assure the highest quality level of laboratory performance and patient's safety.

The Role of Croatian Accreditation Agency in Accreditation of Medical Biochemical Laboratories

According to the Law on Accreditation (Official Gazette 158/2003) and HRN EN ISO/IEC 17000 accreditation is defined as a process by which an independent and authorized official body accredits the quality system and competence of a laboratory to perform certain activities on the basis of some pre-defined standards. Croatian Accreditation Agency (HAA) is established as official organization in July 2005. By the Decree of the Government of the Republic of Croatia (Official Gazette 158/2004; 44/2005) it has full membership in European co-operation for Accreditation (EA). EA evaluates the performance of HAA and signing of the EA Multilateral Agreement on acceptance of accreditation results (EA MLA) is now in progress. HAA co-operates with other international and European accreditation organizations (ILAC, IAF).

In agreement with the Ministry of Health and Social Care, CCMB and CSMB one of the fields of HAA's activities is accreditation of medical biochemical laboratories according to the norm HRN EN ISO 15189, Medical laboratories – Particular requirements for quality and competence, supervision on accredited laboratories, and furthermore, promotion of accreditation and education in that field. Accreditation is conducted on voluntary basis.

Accreditation procedure of medical biochemical laboratories includes: pre-application activities, request for accreditation, application for accreditation and definition of the scope of accreditation, appointing the assessors' team, review of documents and records, on site review, reporting and decision making on accreditation.

The accreditation certificate is valid for the period of 5 years. During that period semi-annual, but more often annual supervisions are carried out. In accreditation period it is possible to broaden the scope of accreditation. Team of assessors includes the lead assessor who conducts on site management system review and leads the assessors group, medical biochemistry assessors which evaluate technical requirements and technical experts for individual highly specific fields. There is established register of assessors of HAA.

Within HAA there is Committee for Laboratories and Working Group for Medical Laboratories (WG MedLab) which include representatives from the Ministry for Health and Social care, CCMB, CSMB and HAA. Activity of WG MedLab is momentary directed to medical biochemical laboratories. The scope of activity of WG MedLab is participation and support to HAA in all activity regarding HRN EN ISO 15189 norm application: issuing regulations and guidelines as help to assessors and laboratories for implementation of individual HRN EN ISO 15189 requirements, participation in making of qualifying criteria and programs for education of assessors, organizing collective evaluations with domestic and international assessors, monitoring of the Technical Committee of the Croatian Institute for Norms where norms for medical biochemical laboratories are issued, co-operation with CCMB and CSMB in implementation of procedures according to the Law on Medical Biochemical Activity. Up to now HAA has accredited 2 clinical medical biochemical laboratories in the Republic of Croatia according to the norm HRN EN ISO 15189:2008, and there are in process several accreditation procedures for medical biochemical laboratories in primary health care.

Experiences of the Institute of Clinical Chemistry, University Hospital »Merkur« in Establishment of the Quality Management System

Institute of Clinical Chemistry as a part of University Hospital »Merkur« is clinical, medical biochemical laboratory that in its daily routine performs requirements for analysis of human biological material by application of more than 200 basic, specialist and highly differentiated medical biochemical tests with help of modern analytical technology and laboratory information technology. Since 1981 the Institute of Clinical Chemistry is involved scientifically and professionally in producing reference values of clinically relevant biochemical and hematological blood elements and in 2000 it has become »Reference Center of Ministry of Health and Social Care for Producing Reference Values in the Field of General Medical Biochemistry«^{8,9}. Today's activities of the Institute are directed to harmonization of laboratory test results based on metrological criteria and traceability concept in laboratory medicine¹⁰. The Institute is a regional representative of EQA on the fields of laboratory hematology

since 1985 and laboratory coagulation since 1990 that is implemented by the World Health Organization (WHO). The Institute of Clinical Chemistry accomplishes its role in stimulating the national quality assessment continuously since 1986 through the co-operation with CSMB, the organizer of national scheme for EQA of medical biochemical laboratories. Highly professional employees of the Institute are involved in organized scientific work, by the scientific activity of the University Hospital »Merkur« in scope of scientific-professional projects of Croatian Ministry of Science, Education and Sport in the research area of new biochemical markers for atherosclerosis in cardiovascular diseases. Through constant care about quality assurance of complete laboratory process all employees of the Institute are directed to continuous quality improvement in all laboratory activities according to modern achievements in laboratory diagnosis. 2001 the procedure for certification according to the norm EN ISO 9001:2000¹¹ is initiated.

The goal of this decision in favor of quality made by the University Hospital »Merkur« lies in training and development with the purpose of continuous quality improvement of clinical hospital and especially laboratory medicine. Therefore, the funding necessary for establishment of quality management system was assured. Introduction of quality management system to the Institute was based on requirements of basic quality management standard EN ISO 9001:2000 Quality Management System – Requirements¹¹ and Code of Quality Systems and Good Laboratory Practice in Medical Biochemical Laboratories of the CCMB, as national standard¹². Certification according to EN ISO 9001:2000 was carried out by authorized certification body RWTÜV – Hrvatska what makes the Institute of Clinical Chemistry of University Hospital »Merkur« the first certified clinical medical biochemical laboratory in Croatia. It is of critical importance to maintain the established quality management system and this is conducted by constant application of corrective and protective actions, by system analysis and evaluation based on measurable data and by assurance of application of all other quality principles, what generated preconditions for accreditation procedure.

The most important activities for accreditation procedure were: Board decision of University Hospital »Merkur« and Institute of Clinical Chemistry to initiate the accreditation procedure, definition of responsibilities and authorization for the complete laboratory process, determination of tests to be accredited, initiation of documentation issuing and implementation of quality management system according to the norm.

Documentation of quality system must assure reproducibility and traceability and offer an objective evidence for effectiveness evaluation of quality system. This is the purpose of Quality Manual that comprises procedures of quality management system and numerous working instructions, records and forms. In audit of the existing ones and issuing the new documents all highly qualified employees of the Institute participated in co-ordination with appointed Quality Manager.

The most valuable resource of the Institute for Clinical Chemistry is its personnel. Due to the fact that knowledge and experience are gained exclusively by education and work and are the most important causes why required quality is sometimes not applied, that is, why an error sometimes occurs, the staff of the Institute was continuously educated. Estimation of education efficiency and making appropriate records contributed to the consciousness of the staff about appropriateness and importance of its activities in achieving goals for improving quality.

For better management of laboratory equipment operator's manuals with documented maintainance procedures, proper calibration and function of instruments were made under exactly defined protocols and dynamic in line with recommendations of the laboratory equipment manufacturer. This way of laboratory equipment maintainance and calibration raised significantly the level of work safety and trust in proper function of measuring instruments and reduced significantly number of urgent service interventions. A very good co-operation has been accomplished with authorized laboratory equipment services regarding fulfilling required quality standards and issuing certifications on validity and also regarding calibration of specific laboratory equipment (laboratory scales, pipettes, pH meters).

Monitoring of the complete laboratory process is made through pre-analytical, analytical and post-analytical phase. In scope of pre-analytical phase there is a Primary Samples Collection Manual with detailed instructions for health workers and patients about patient's preparation for blood samples collection, standard sampling procedures, criteria for acceptance and/or rejection of primary samples, so that the sample would be optimal. Therefore, the complete control of pre-analytical phase is very important, what is very often hard to accomplish in hospital conditions where sampling takes place outside of laboratory control.

In scope of analytical phase, quality assurance of testing procedures is an everyday routine, accompanied by adequate statistical processing and analysis of obtained test results according to required criteria for acceptance of laboratory analyses results. Standard laboratory testing procedures are validated; however, there is still a need for a better definition of validating indicators and their detailed documentation according to the newest expert recommendations. Measurement uncertainty is calculated for quantitative measuring procedures and is published on the web site of University Hospital »Merkur«. Laboratory test results traceability is extremely important and for the complete understanding of its significance additional education is necessary¹³.

In scope of post-analytical phase there are documented procedures about results reporting of laboratory analyses in graphical or electronic form as well as giving information to clinicians about critical values. Development of laboratory information system was a necessary precondition for quality improvement in this phase of laboratory process which was fully supported by the

Board of the Hospital. Laboratory test results validated by medical biochemists are stored automatically in predefined test result report forms generated according to propositions of IUPAC-IFCC (IUPAC-IFCC Recommendation, 1993). Today, the laboratory information system is an integral part of hospital system and as such it enables secure results transmission of laboratory analyses to very informative laboratory test result reports, what contributes considerably to a faster and more efficient patient care.

User's satisfaction is one of the most important efficacy indicators of quality management system. Therefore, in the Institute we regularly analyze the book of impressions written by patients and conduct surveys among patients and doctors. By monitoring of user's complaints and analyzing the cause of incompliance we gain data not only about situations that make our users not satisfied but also about what actions are to be taken in order to anticipate those situations and how to prevent them. The Institute for Clinical Chemistry depends on its users and therefore it tends to understand their present and future needs, fulfil their requirements and excel their expectations.

The main permanent goal for all employees of the Institute was to achieve by the implementation of quality management system continuous improvement of all laboratory activities. Therefore, the goal of internal audit of quality management system is to confirm whether the regulations of quality assurance are present in required range and whether these regulations are respected and implemented. Another goal is to promote possible improvements. In the Institute of Clinical Chemistry internal audits are conducted by educated internal assessors in co-ordination with Quality Manager according to a yearly plan in all departments mainly through vertical audit, documentation control, monitoring of activities, analyzing incompliances, interviewing the laboratory staff and checking the application of legal regulations and experts algorithms. Recent experience proves that by implementation of improvement measures based on the results of internal audits the quality of laboratory

tests has been raised to the higher level, problems related to internal quality controls have been diminished, time required for laboratory tests has been considerably reduced and observed incompliances are eliminated in very short time.

After application for accreditation to HAA on site supervision has been conducted which results showed that the requirements are fulfilled in the part of requirements for organization and management presented in management review through quality improvement plan, analysis of complaints from laboratory users, analysis of laboratory performance efficiency, staff education, carrying out of internal audits and suppliers evaluation. In the part of technical requirements metrological criteria are fulfilled through implemented calibration and thermometer control, calibration of pipettes, evaluation of internal quality control system, calculation of measurement uncertainty and validation of testing procedures. Confirmation on accreditation was issued on December 31, 2007, which states that the Institute of Clinical Chemistry in University Hospital »Mercur« is accredited according to the norm HRN EN ISO 15189:2006 Medical laboratories – Particular requirements for quality and competence for medical biochemical activity on the field of clinical chemistry, laboratory hematology and coagulation, laboratory immunology – cell immunophenotyping and molecular diagnostics.

Conclusion

Development of the complete quality management system in medical biochemical laboratories according to international standards requires monitoring and supervision of all laboratory processes which end as laboratory test result report. Therefore, advantages of accredited laboratory are documented management system, continuous improvement and training, reliability of test results, establishment of laboratory users' trust, test results comparability and inter-laboratory (international) test result acceptance based on the concept of metrological traceability in laboratory medicine.

REFERENCES

1. Nacionalna strategija razvitka zdravstva 2006–2011.g. Available from: URL: http://www.pravo.hr/download/repository/Nacionalna_strategija_razvitka_zdravstva_2006_2011.ppt. — 2. International Organisation for Standardisation. EN ISO 15189:2003 Medical laboratories – Particular requirements for quality and competence. — 3. STAVLJENIĆ-RUKAVINA A, ČVORIŠEĆ D, Vanjska i unutarnja provjera kvalitete bolnica i medicinskih laboratorija (Ministarstvo zdravstva RH, Medicinski fakultet Sveučilišta u Zagrebu, Škola narodnog zdravlja »A. Štampar«, Hrvatska komora medicinskih biokemičara, Zagreb, 2002). — 4. JURETIĆ D, ČEPELAK I, FLEGAR-MEŠTRIĆ Z, Clin Chem Lab Med, 37 (1999) 667. — 5. JURETIĆ D, FLEGAR-MEŠTRIĆ Z, ČEPELAK I, NAZOR A, PARAG G, SIKIRICA M, EQA News, 13 (2002) 45. — 6. FLEGAR-MEŠTRIĆ Z, NAZOR A, PARAG G, SIKIRICA M, PERKOV S, JURETIĆ D, Biochimica Medica, 15 (2005) 15. — 7. ČVORIŠEĆ D, Stručni nadzor nad radom medicinsko biokemijskih laboratorija i medicinskim

- biokemičarima (Hrvatska komora medicinskih biokemičara i Medicinska naklada, Zagreb, 2005). — 8. ALBERT-ŠUBIĆ N, TADEJ D, Referentne vrijednosti klinički relevantnih sastojaka krvi i seruma. Model: Populacija Zagreba i bliže okolice (Školska knjiga, Zagreb, 1990). — 9. FLEGAR-MEŠTRIĆ Z, JAGARINEC N, Referentne vrijednosti biokemijskih i hematoloških sastojaka krvi u školske djece i adolescenata grada Zagreba (Medicinska naklada, Zagreb, 1997). — 10. STAVLJENIĆ-RUKAVINA A, ČVORIŠEĆ D, Harmonizacija laboratorijskih nalaza u području opće medicinske biokemije (Hrvatska komora medicinskih biokemičara i Medicinska naklada, Zagreb, 2005). — 11. International Organisation for Standardisation. ISO 9001:2000 Quality management systems – Requirements (2000). — 12. Pravilnik o kvalitativnim sustavima i dobroj laboratorijskoj praksi u medicinsko-biokemijskim laboratorijima (Hrvatska komora medicinskih biokemičara, Zagreb, 1995). — 13. ARMBRUSTER DA, Labquality News, 1 (2005) 10.

Z. Flegar-Meštrić

*Institute of Clinical Chemistry, University Hospital »Merkur«, Zajčeva 19, 10000 Zagreb
e-mail: zlata.mestric@zg.t-com.hr*

AKREDITACIJA MEDICINSKIH LABORATORIJA U HRVATSKOJ – ISKUSTVA ZAVODA ZA KLINIČKU KEMIJU KLINIČKE BOLNICE »MERKUR«, ZAGREB

S A Ž E T A K

Od 2003. god. kada je usvojena i objavljena međunarodna norma za uvođenje sustava upravljanja kvalitetom u medicinske laboratorije (EN ISO 15189, Medical laboratories – Particular requirements for quality and competence) akreditacije je postala praktičan, opće prihvaćen način za upravljanje kvalitetom i potvrdu tehničke osposobljenosti medicinskih laboratorija u cijelom svijetu. Ova norma je prevedena na hrvatski jezik i prihvaćena od Hrvatskog zavoda za norme kao hrvatska norma: HRN EN ISO 15189:2006, Medicinski laboratoriji – Posebni zahtjevi za kvalitetu i osposobljenost. Akreditacija se provodi kao dobrovoljna akreditacija od strane Hrvatske akreditacijske agencije koja je do danas dodijelila 2 akreditacije kliničkim medicinsko biokemijskim laboratorijima u Hrvatskoj. Prednosti akreditiranog laboratorija su dokumentirani sustav upravljanja, neprestano poboljšavanje i usavršavanje, pouzdanost rezultata ispitivanja, uspostava povjerenja korisnika laboratorijskih usluga, te usporedivost rezultata i međusobno (međunarodno) prihvaćanje rezultata ispitivanja usvajanjem koncepta mjeriteljske sljedivosti u laboratorijskoj medicini.