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Review

Standardization in laboratory medicine: New challenges

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Abstract

The primary goal of Laboratory Medicine is to provide information that is useful to assist medical decision-making and permits optimal health care. This type of information should be independently obtained of the measurement test kits and instruments, and also of the laboratory where the procedure is carried out. It is therefore important to achieve a level of comparability of laboratory results among the many measurement procedures available so that results are harmonized and interchangeable over space and time. The standardization of measurements is therefore of high priority. In recent years, numerous efforts have been made at the international level under the auspices of the IFCC and other organizations to standardize measurement results for many important analytes, e.g. enzymes, cardiac proteins, etc. The aim of this review is to discuss some concepts related to the achievement of standardization by the implementation of a metrologically correct measurement system, providing some examples on how these concepts can be applied in Laboratory Medicine.

Keywords: Standardization; Traceability; Reference materials; Calibration; Certification

Abbreviations: ISO, International Organization for Standardization; IVD, in vitro diagnostic; SI, International System; WHO, World Health Organization; ID-GC/MS, isotope dilution-gas chromatography/mass spectrometry; ICRMP, international conventional reference measurement procedure; IFCC, International Federation of Clinical Chemistry and Laboratory Medicine; CK, creatine kinase; LDH, lactate dehydrogenase; ALT, alanine aminotrasferase; AST, aspartate aminotransferase; GGT, γ-glutamyltransferase; AMY, α-amylase; ALP, alkaline phosphatase; IRMM, Institute for Reference Materials and Measurements; BCR, Community Bureau of Reference; HbA1c, hemoglobin A1c; HPLC, high-pressure liquid chromatography; cTnI, cardiac troponin I; AACC, American Association for Clinical Chemistry; NIST, National Institute of Standards and Technology; MALDI, matrix assisted laser desorption/ionization; BIPM, International Bureau of Weights and Measures; JCTLM, Joint Committee on Traceability in Laboratory Medicine; ILAC, International Laboratory Accreditation Cooperation.

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Contents

1. Introduction

The primary goal of Laboratory Medicine is to provide information that is useful to assist medical decision-making, allowing optimal health care [1]. This can only be obtained by generating reliable analytical results on patient samples [2]. Meaningful measurements are indeed essential for the diagnosis, monitoring, treatment, and risk assessment of patients [3]. Inadequate laboratory performance may have extensive consequences for practical medicine, health-care system, and, in conclusion, for the patient. Poor-quality results may actually lead to incorrect interpretation by the clinician, impairing the patient's situation.

Foremost among the laboratory problems is the poor comparability of analytical results, especially when they originate from different laboratories using different methods [4]. Nowadays, considerable differences can still be observed in the results of different measurement procedures for the same analyte [5,6]. Analytical systems give results that are typical of a particular method or instrument, so that different results from different assays and platforms may be obtained for a given analyte. Such a situation may cloud interpretations of reported data, creating a substantive problem for both clinician and laboratory communities [7]. Most importantly, inability to define common reference intervals or decision limits for a particular biomarker may create confusion among clinicians when results are interpreted [8]. The achievement of the standardization of laboratory measurements, assuring interchangeability of results over time and space, would therefore significantly contribute to improvements in health care, since results of clinical studies undertaken in different locations or times could be universally applied. This would allow an effective application of evidence-based medicine, e.g. guidelines established by scientific or professional bodies often advocating use of specific decision limits for diagnosis and therapeutic intervention [9].

2. Historical background

The recognition that it is standardization of results that requires improvement in Laboratory Medicine rose in recent years questions about the causes for the lack of standardization [2,4]. The first and principal step to improve standardization is that which makes the measurement system metrologically correct [3,10]. The importance of the metrological principles has recently been described in two International Organization for Standardization (ISO) documents, the ISO 17511 and 18153 [11,12]. In these documents, the traceability to internationally recognized and accepted reference materials and measurement procedures is considered the key element in assuring the accuracy and comparability of clinical laboratory measurements. The recent European directive on in vitro diagnostic (IVD) devices follows these ISO standards and requests application of the standards for all IVD reagents used within the European Union [13]. This