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Verification of analytical performance of Microalbuminuria assay on the Abbott Alinity ci®: Experience of the central laboratory of Mohammed VI University Hospital of Oujda

Yassir El Azraky [1, 2, *], Dounia Elmoujtahide [1, 2], El Houcine Sebbar [1, 2] and Mohammed Choukri [1, 2]

[1] *Mohammed First University, Faculty of Medicine and Pharmacy of Oujda, Morocco.*
[2] *Biochemistry laboratory of Mohammed VI University Hospital, Oujda, Morocco.*

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Abstract

The verification of analytical methods is crucial to ensure the accuracy of results. This study evaluates the performance of the microalbuminuria assay method in the central laboratory of CHU Mohammed VI in Oujda, to confirm its reliability for the diagnosis and monitoring of renal disorders and related conditions.

We conducted a performance study of the Alinity ci® system by assessing repeatability and reproducibility in accordance with the COFRAC GTA 04 technical accreditation guidelines, in line with the quality requirements of the ISO 15189 standard.

The results of our study indicate satisfactory repeatability for the two levels (low and high), with coefficients of variation of 1.24% and 1.12%, respectively. Additionally, reproducibility was also satisfactory, with coefficients of variation for these same levels of 4.73% and 4.75%, respectively.

The reliability of the microalbuminuria assay results in our laboratory is confirmed by the satisfactory results obtained in our study, which comply with the recommendations of RICOS and FSCB.

Keywords: Microalbuminuria; Analytical Performance; Repeatability; Reproducibility; Alinity CI Analyzer

1. Introduction

Quality is an ongoing process aimed at ensuring the accurate and consistent execution of tests. A comprehensive quality assurance system encompasses all internal and external laboratory activities, promoting adherence to proper practices and enhancing management capabilities. Its primary objective is to guarantee that each assay performed by the laboratory is both precise and dependable. To successfully implement quality principles in medical laboratories, it is crucial to establish a focused quality management process that upholds the reliability of results [1].

The verification of analytical methods is vital for evaluating and ensuring the performance, reliability, and precision of laboratory techniques. This process includes following standardized operating protocols and assessing methods against criteria established by professional organizations such as RICOS and FSCB, as well as the manufacturer. In addition to meeting regulatory requirements specified in the Moroccan Guide for the Good Performance of Medical Laboratory Analysis (GBEA) and the ISO 15189:2022 standard, this verification provides laboratories with a deeper understanding of their analytical methods, their performance, and their limitations, thereby ensuring result accuracy for the benefit of both patients and healthcare providers. Consequently, ensuring adequate performance is essential [2,3,4].

* Corresponding author: Yassir El Azraky.

Our study focuses on the in-depth analysis of the analytical performance of the microalbuminuria test on the Abbott Alinity ci automated system. We have established a method verification protocol for this test, examining several key parameters in detail, such as precision, accuracy, and reliability of measurements. This analysis is crucial not only for strengthening laboratory practices and improving diagnostic approaches but also for serving as an essential foundation for an accreditation procedure, demonstrating our commitment to a rigorous quality process within our laboratory.

1.1. Microalbuminuria and clinical Significance

Under normal conditions, daily albumin excretion ranges from 5 to 10 mg. Forty years ago, a technology for measuring small amounts of urinary albumin was developed to identify abnormal albumin excretion or albuminuria [5,6] Microalbuminuria is defined as an abnormal increase in the rate of albumin excretion within the specific range of 30 to 299 mg of albumin/g of creatinine. The term was coined in the early 1980s[7] when technological advances made it possible to detect small but abnormal increases in albumin in the urine of patients with diabetes and other conditions, hence the term "microalbuminuria."

Expressing albumin as a ratio to creatinine is preferred because it allows the use of a routine (spot) urine sample to detect abnormal albumin levels, eliminating the need for a 24-hour urine collection. The National Kidney Foundation, the American Diabetes Association, and the National Institutes of Health recommend measuring urinary albumin using the albumin-to-creatinine ratio technique [8,9] Persistent microalbuminuria is a marker of increased vascular permeability associated with various cardiovascular risk factors. However, it is not definitive proof of nephropathy, although some type 1 and type 2 diabetics with microalbuminuria may develop nephropathy over time [10,11].

1.2. Principle of the assay method

The Microalbumin assay is an immunoturbidimetric assay using polyclonal antibodies directed against human albumin. When a sample is mixed with the reagents, the albumin present in the sample binds to the anti-human albumin (goat) antibodies in the reagent to form an insoluble aggregate, which increases the turbidity of the solution. The degree of turbidity is proportional to the albumin concentration in the sample and can be measured optically.

Methodology: Turbidimetric/Immunoturbidimetric

2. Material and methods

This study is a prospective investigation conducted within the biochemistry laboratory of Mohammed VI University Hospital. Our primary objective was to assess the analytical performance of microalbuminuria determination using the "Chemistry" module on the Abbott Alinity ci® Analyzer. The study was carried out over a specified period and adhered to the recommendations outlined in the accreditation technical guide of the French accreditation committee (COFRAC), protocol GTA 04. The findings from this study will provide essential insights into the accuracy and reliability of microalbuminuria determination in a hospital setting.

The study was structured into two distinct phases. Initially, we evaluated the intermediate fidelity, also known as intra-laboratory reproducibility, by conducting daily internal quality controls with samples at varying concentrations—low, medium, and high—over a 30-day period. In the second phase, we assembled a comprehensive collection of serum samples, ensuring an equitable distribution of microalbuminuria values across the entire measurement spectrum. These collected samples were categorized into two groups representing low and high microalbuminuria levels. To assess repeatability, each serum sample underwent 30 individual assay runs.

The microalbuminuria evaluation utilized a dedicated reagent kit on the chemistry module. Subsequently, data processing was performed via the BYG middleware, which connects the Alinity platform to the iLab result validation software. The coefficient of variation (CV) values obtained from this study were then compared to the reference standards established by respected professional organizations and the supplier, specifically the Federation of Clinical Chemistry and Laboratory Medicine (FSCB) and the Reference Institute for Bioanalytics (RICOS).

3. Results

3.1. Reproducibility results

The intra-laboratory reproducibility involves assessing the same sample under different conditions by changing at least one variable, such as the operator, time, reagent batches, or calibration settings. This approach helps establish

acceptance criteria grounded in existing knowledge, especially considering biological variations within decision support systems. By testing the sample under various conditions and carefully analyzing the resulting data, researchers can evaluate how these factors influence the test's accuracy and reliability. This method improves the understanding of the test's robustness and performance, ultimately supporting the development and optimization of diagnostic methods and enhancing the overall quality of laboratory analyses in clinical diagnostics [12]

Table 1 Reproducibility results of blood assays by level compared to the manufacturer's specifications**.**

Level of Internal quality control (IQC)	Number of values	Mean (mg/l)	Standard Deviation (g/l)	Coefficient of Variation CV (%)	CV SFBC 1999 (%)
Low level	30	29.81	1.409	4.73	8.00
High level	30	89.35	4.242	4.75	6.00

The results of our study indicate satisfactory reproducibility for the three levels (low, medium, and high), with coefficients of variation of 4.73% and 4.75%, respectively.

To enhance clarity regarding these results, they have been visually illustrated using Levey-Jennings plots (Fig. 1 and Fig. 2).

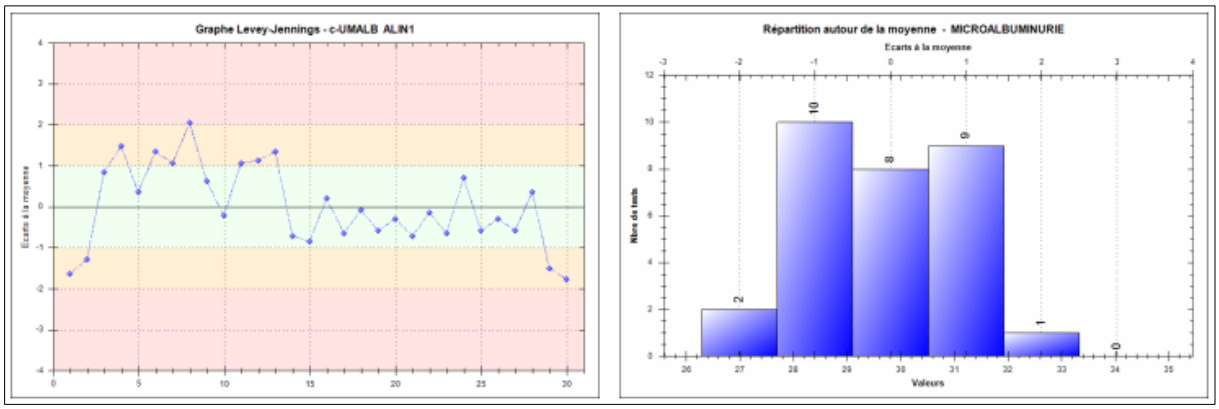

Figure 1 Low level of reproducibility: Levey Jennings graph and the distribution around the mean

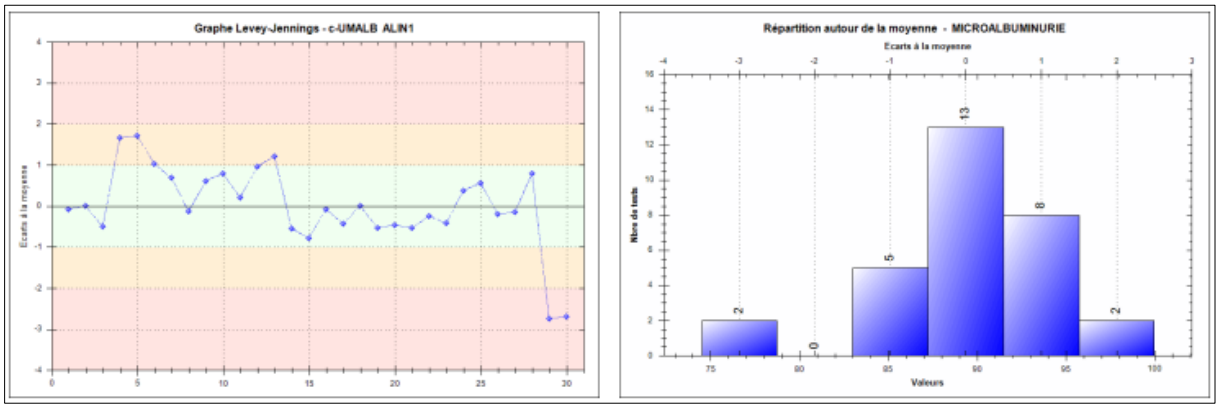

Figure 2 High level of reproducibility: Levey Jennings graph and the distribution around the mean

3.2. Repeatability results

Repeatability is assessed by having the same operator perform multiple assays on identical samples under controlled conditions, considering all measurement variables such as reagents, calibration, instrument, and operator, while minimizing the time between tests. This process helps establish baseline performance and ensures the proper functioning of the system (instrument/reagent) for the specific analyte [13] Additionally, variability is quantified by calculating the coefficient of variation (CV) values.

Table 2 Repeatability results for microalbuminia on the Alinity i® automated system by level, compared to the manufacturer's specifications.

Level of Internal quality control (IQC)	Number of values	Mean (g/l)	Standard Deviation (g/l)	Coefficient of Variation CV (%)	CV SFBC 1999 (%)
Low level	30	29.04	0.361	1.24	6.00
High level	30	88.52	0.989	1.12	4.50

The results of our study indicate satisfactory repeatability, with coefficients of variation for these levels of 1.24 and 1.12%, respectively.

These findings are displayed using Levey-Jennings plots, providing a clearer illustration of the results (Fig. 3 and Fig. 4).

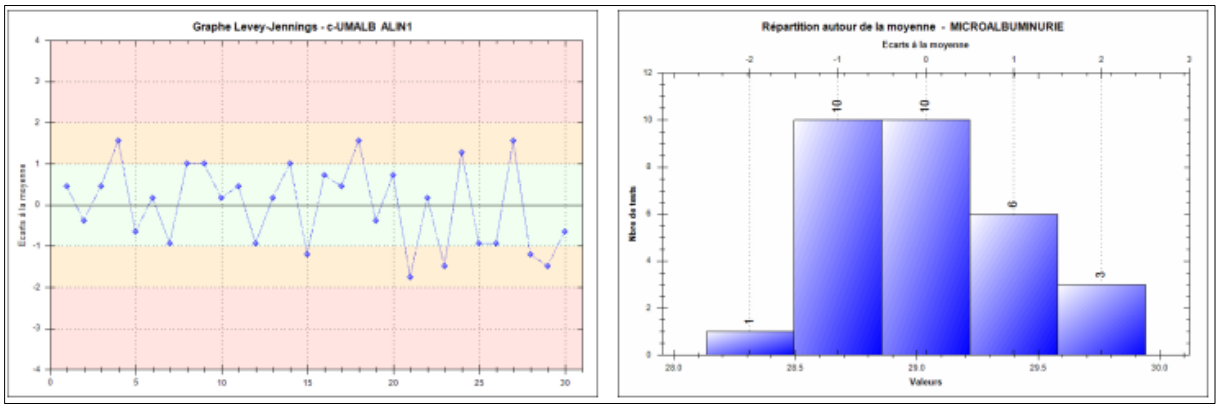

Figure 3 Low level of repeatability: Levey Jennings graph and the distribution around the mean

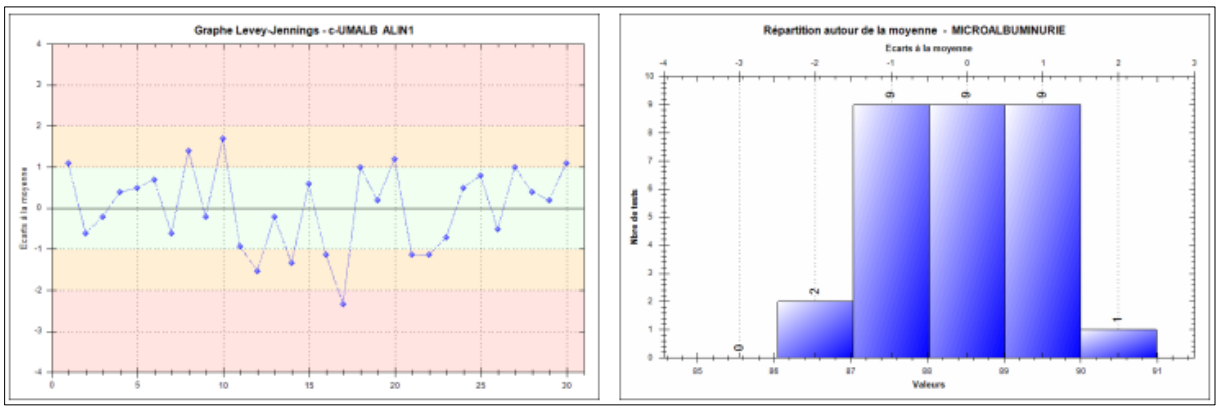

Figure 4 High level of repeatability Levey Jennings graph and the distribution around the mean

4. Discussion

There are several methods available for assessing urinary albumin excretion, ranging from microalbuminuria in very low concentrations to higher levels, including macroalbuminuria or proteinuria. Immunonephelometry: In this method, albumin in the urine sample interacts with an antibody against human albumin, triggering an antigen-antibody reaction. The increase in light scatter caused by this reaction is optically measured to determine the concentration of microalbuminuria. Immunoturbidimetry**:** This technique involves competition between albumin in the urine sample and human albumin bound to latex particles for a monoclonal antibody, which aggregates the latex particles. The resulting amount of aggregation is inversely proportional to the concentration of albumin in the urine sample. The aggregation is optically measured and mathematically converted into a microalbuminuria concentration [14]

It is important to note that comparisons of these laboratory methods for detecting and measuring albumin in urine have shown considerable variation in results. For example, in one study, immunonephelometry provided values roughly three times lower than immunoturbidimetry, meaning that an album in concentration of around 30 mg/mL (microalbuminuria range) measured by immunoturbidimetry would be recorded as about 10 mg/mL (normoalbuminuric range) with immunonephelometry[15] In other studies, radioimmunoassay showed values 1.4 times lower than immunonephelometry and over six times lower than immunoturbidimetry[16] while immunonephelometry provided values 1.6 times lower than immunoturbidimetry[17]

Mastering the analytical method used by laboratory personnel is a continuous priority, and its verification or validation is both a regulatory requirement (as outlined in the Moroccan Guide for the Good Performance of Medical Laboratory Analyses) and a standard requirement (according to ISO 15189:2012)[18] By establishing predefined analytical goals, this mastery ensures the production of accurate and reliable results.

The reproducibility test is a key tool for evaluating the consistency of assay results when subjected to varying conditions, such as changes in operators, time intervals, reagent batches, and calibration processes, all of which can influence the reliability of the outcomes. To measure this variability, the Coefficient of Variation (CV) is used. The CV indicates the extent to which the results deviate from the average, reflecting the dispersion of the data. For the low, medium, and high levels, the CV values were 4.73% and 4.75%, respectively. These relatively low values suggest that the assay produces consistent results under varying conditions.

The reproducibility results show that the microalbuminemia assay is stable and reliable, even when factors such as the operator or reagent batch change. This stability is essential in clinical testing, where consistent and trustworthy results are required for decision-making. Moreover, the CV values fall within the expected quality control limits, confirming that the assay meets industry standards for reproducibility, making it suitable for accurate diagnostic use.

The repeatability test, on the other hand, assesses the precision of the assay when performed under controlled, optimal conditions. This test evaluates how consistently the method delivers the same results when the same sample is analyzed multiple times. The CV values for repeatability are low: 1.24 and 1.12%. These low values indicate minimal variability, confirming the assay's high precision.

The repeatability results show that the microalbuminemia assay provides highly precise and consistent measurements when the same sample is analyzed repeatedly. The low CV values highlight the stability and predictability of the assay under controlled conditions. This precision is particularly important in clinical diagnostics, where even minor variations can significantly impact patient care. The alignment of the CV values with quality control standards further validates the reliability and suitability of the assay for producing repeatable and accurate results.

Together, the reproducibility and repeatability results highlight the robustness and reliability of the microalbuminemia assay. The assay shows low variability and high precision across different conditions and repeated analyses of the same sample. These qualities are crucial in clinical diagnostics, where dependable and accurate results are essential for patient care. The comparison with quality control standards provides an objective validation of the assay's performance, assuring healthcare professionals and researchers that the method delivers consistent, trustworthy results. This thorough evaluation of variability ensures that the assay meets industry standards and can be confidently used in clinical decision-making.

5. Conclusion

The analytical performance of the Alinity CI automated system was satisfactory for reliable microalbuminemia determination. Verification of assay methods in medical laboratories is essential to ensuring the accuracy, precision, and reliability of test results. This process involves confirming that the test method used is suitable for its intended purpose, produces results consistent with the claimed performance characteristics, and adheres to the laboratory's quality control and assurance requirements.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Abdel Ghafar MT, El-Masry MI. Verification of quantitative analytical methods in medical laboratories. J Med Biochem. 2021 Jun 5 ;40(3) :225–36.

[2] [2] Vassault A, Hulin A, Chapuzet E, Arnaud J, Giroud C, members of the SFBC Analytical Subgroup 2. [Verification/validation of the performance of analytical methods]. Ann Biol Clin (Paris). Dec 2010; 68 Spec No 1: 247-94.

[3] [3] Pum J. A practical guide to validation and verification of analytical methods in the clinical laboratory. Adv Clin Chem. 2019; 90: 215-81.

[4] [4] Masson E. EM-Consulte. [cited 2024 Jan 14]. Guide to the proper execution of medical biology analyses (GBEA): its application in the public hospital sector. Available from: https://www.emconsulte.com/article/191898/guide-de-bonne-execution-des-analyses-de-biologie

[5] Keen H, Chlouverakis C. An immunoassay method for urinary albumin at low concentrations. Lancet. 1963; 186: 913–914.

[6] Keen H, Chlouverakis C. Urinary albumin excretion and diabetes mellitus. Lancet. 1964; 14: 1155–1156.

[7] Viberti GC, Keen H. Microalbuminuria and diabetes. Lancet.1983; 1: 352.

[8] American Dibetes Association. Standards of medical care for patients with diabetes mellitus. Diabetes Care. 2003; 26: S33–S50.

[9] Eknoyan G, Hostetter T, Bakris GL, et al. Proteinuria and other markers of chronic kidney disease: a position statement of the National Kidney Foundation and the National Institute of Diabetes and Digestive and Kidney Diseases. Am J Kidney Dis. 2003; 42: 617–622.

[10] Viberti GC, Jarrett RJ, Keen H. Microalbuminuria as prediction of nephropathy in diabetics. Lancet. 1982; 2: 611.

[11] Mogensen CE. Microalbuminuria predicts clinical proteinuria and early mortality in maturity-onset diabetes. N Engl J Med. 1984; 310: 356–360.

[12] R. R. Beer et al., « Validation and verification of examination procedures in medical laboratories: opinion of the EFLM Working Group Accreditation and ISO/CEN standards (WG-A/ISO) on dealing with ISO 15189:2012 demands for method verification and validation », Clinical Chemistry and Laboratory Medicine (CCLM), vol. 58, no 3, p. 361-367, mars 2020, doi: 10.1515/cclm-2019-1053

[13] S. La Franchi, Graves' disease, congenital hypothyroidism, and maternal thyroid disease during pregnancy, Growth Horm. IGF Res. 16 (2006) S20eS24.

[14] Busby DE, Bakris GL. Comparison of Commonly Used Assays for the Detection of Microalbuminuria. J Clin Hypertens. nov 2004;6(s11):8-12.

[15] Comper WD, Jerums G, Osicka TM. Differences in urinary albumin detected by four immunoassays and high-performance liquid chromatography. Clin Biochem. 2004; 37: 105–111.

[16] Giampietro O, Penno G, Clerico A, et al. Which method for quantifying “microalbuminuria’ in diabetes? Comparison of several immunological methods (immunoturbidimetric assay, immunonephelometric assay, radioimmunoassay and two semiquantitative tests) for measurement of albumin in urine. Acta Diabetol. 1992; 28:239–245.

[17] Roberts WL, Calcote CB, Cook CB, et al. Comparison of four commercial urinary albumin (microalbumin) methods: implications for detecting diabetic nephropathy using random urine specimens. Clin Chim Acta. 1998 ;273 :21–33.

[18] ISO 15189:2012 - Medical laboratories - Requirements for quality and competence. [cited 2020 Feb 7]. Available from: https://www.iso. org/fr/standard/56115.html.