HbA1c laboratory quality performance of National External Quality Assessment Program (PNAEQ) in the EurA1c project: 2017–2024

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Introduction and Objective

The determination of glycated hemoglobin (HbA1c) is used in patients with diabetes mellitus as a key to monitoring the long-term blood glucose control [(1)].

The Portuguese National External Quality Assessment Program (PNAEQ), organizes since 2003 the Hemoglobin glycated (HbA1c) program for External Quality Assessment Laboratory and integrated the IFCC EurA1c project in 2017.

External Quality Assessment (EQA) is a powerful education tool to monitor quality that, by identifying poor performing laboratories and test systems, can be used as a tool to improve quality [(2)].

The aim of this work is to monitor the analytical performance of HbA1c determination, performed by PNAEQ participants, based on results of their participation in EurA1c project (bias (%) and coefficient of variation (CV%).

Methods

From 2017 to 2024, PNAEQ laboratory participants (mean=41), from public and private sectors of ambulatory and hospital care, analysed in first round, two control samples per year, (n=16), with different concentrations (samples below and above 48mmol/mol). The samples sent from EurA1c project were lyophilized hemolysate specimens manufactured from the same pool.

Participants HbA1c results, in IFCC units, were evaluated by comparison with target values assessed by EurA1c project. Usually, values were assigned by five laboratories using the IFCC Reference Measurement Procedure. EFLM Specification Limits for reference were consulted in July 7th 2025.

The statistical analysis followed the EurA1c project´s methodology. Outliers- defined as results differing by more than 25% from the target value- were excluded prior to calculating the mean, CV% and bias%. Performance comparisons were performed with Wilcoxon test considering a significance of 5%.

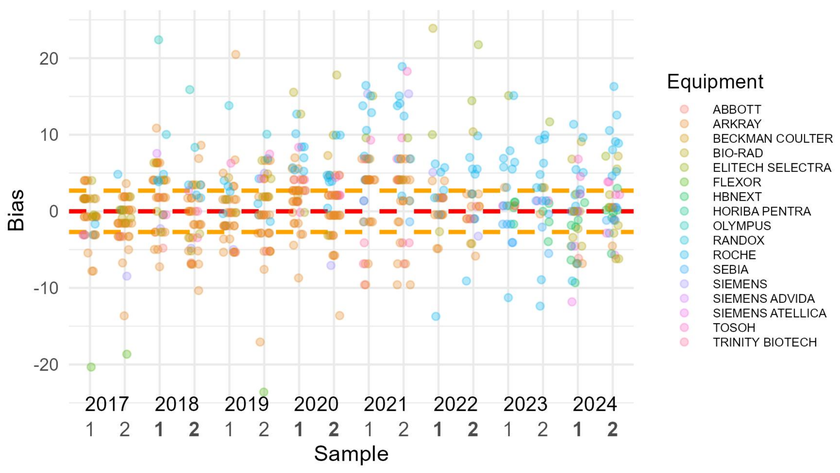
Results

During the study period, an average of 41 laboratories participated (range: 26–49). A total of 17 different types of equipment and 9 distinct methodologies were used.

From 2022 onwards, a noticeable shift in equipment and/or methodology was observed among several participants (Figure 1). Notably, five laboratories consistently submitted results for all samples throughout the study (Figure 2). Considering pathogenicity of samples, no significant difference was observed in Bias distributions comparing pathological and non-pathological samples (*p-value*=0.069). Before COVID arrived, a mean bias value of 0.7 was observed, which increased to 2.1 afterwards, with a significant difference (*p-value*= 0.002).

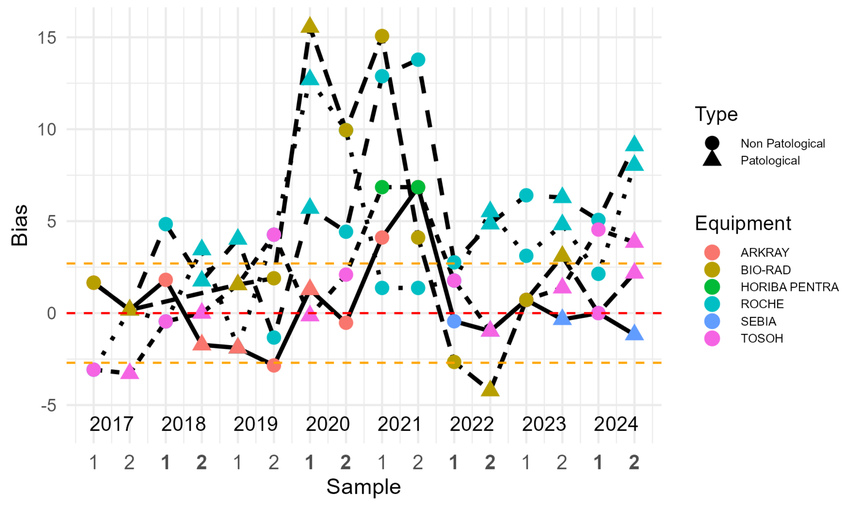
Based on the minimum EFLM quality specifications for HbA1c bias (2.7%), the mean bias of participants meets the established criteria in 13 samples. Regarding the desirable specification (1.8%), 10 samples and regarding the optimal specification (0.9%), 5 samples were compliant. During the pandemic period, 3 samples did not meet the minimum specifications.

Regarding CV's, and considering average in each year, we can see a change in trend considering the pandemic appearance (Figure 3). There was no significant difference in the CV% distributions between pathological samples and non-pathological samples (respectively means of 5.1 and 5.7, p-value=0.151).



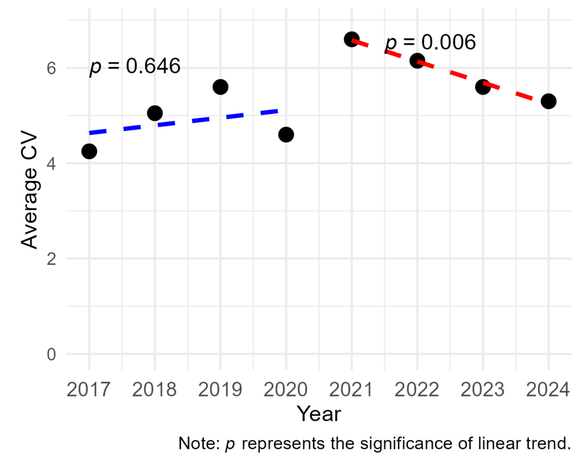
Note: The Specifications Limit is represented by orange dashed lines.

Figure 1: Laboratory bias by sample with equipment information.



Note: The Specifications Limit is represented by orange dashed lines.

Figure 2: Laboratory bias by sample (participants in all trials).



Note: *p* represents the significance of linear trend.

Figure 3: Average CV in each each with linear trends.

Discussion and Conclusions

- ✓ During the study period, the laboratories changed equipment without showing performance improvements.
- ✓ There is a clear sign of impacts of pandemic in laboratories performance, although there are some signs of approaching to previous levels
- ✓ Most samples met the minimum quality specifications for HbA1c bias established by the EFLM, with a substantial proportion also meeting desirable and optimal targets.
- ✓ These findings highlight the effectiveness of the EurA1c external quality assessment framework in supporting continuous quality improvement in HbA1c testing across Portuguese laboratories.

Referencias

(1)Norma nº 033/2011, Prescrição e determinação da hemoglobina glicada A1c

(2)EurA1c Trial Group. EurA1c: The European HbA1c Trial to Investigate the Performance of HbA1c Assays in 2166 Laboratories across 17 Countries and 24 Manufacturers by Use of the IFCC Model for Quality Targets. Clin Chem. 2018 Aug;64(8):1183-1192.