
Multi-method Comparison of Point of Care A1C Testing Analyzers

Abstract

A wide variety of methods are available for the measurement of A1C including, boronate affinity chromatography, immuno-agglutination, and immunoassay. In the present study, accuracy of four point of care testing methods were assessed and compared with a clinical diagnostic laboratory reference method. Precision was also assessed. The hospital staff obtained whole blood samples from 30 patients. Correlation coefficient for each method compared to the reference method were: Cholestech GDX ($r = 0.99$), DCA 2000 ($r = 0.99$), A1cNow ($r = 0.97$) and the NycoCard ($r = 0.83$). Bland-Altman graphs were used to determine bias of the A1C results. The Cholestech GDX and DCA 2000 met the NGSP accuracy criterion of 95% CI within $\pm 1\%$, A1cNow and NycoCard at, 90% and 70%, respectively, did not. The precision of all methods met the new, tighter criterion of $\leq 4\%$ CV set by the NGSP with the exception of A1cNow result of 5.2% CV.

Introduction

Hemoglobin A_{1c} (A1C) measurement provides the most objective and reliable information, necessary for determining long-term glucose control in diabetic patients¹. A wide variety of methods are available for the measurement of A1C including, boronate affinity chromatography, immuno-agglutination, and immunoassay.

The National Glycohemoglobin Standardization Program (NGSP) has standardized hemoglobin A1C test results by setting stringent requirements for accuracy and precision so that the results are comparable to those reported in the Diabetes Control and Complications Trial (DCCT) where risk for vascular complications have been established. NGSP certification requires annual renewal to ensure that methods continue to meet requirements^{2,3}. The standardization program includes the use of fast, accurate, and precise analyzers, suitable for both point of care testing (POCT) and centralized laboratories.

Methods

A multi-method study was conducted to compare the reliability of these methods using 4 POCT analyzers: the Cholestech GDX™ (Cholestech), DCA 2000® (Bayer), A1cNow™ (Metrika), and the NycoCard® (Axis Shield). The Cholestech GDX and the NycoCard use boronate affinity chromatography, the DCA 2000 uses immuno-agglutination and the A1cNow uses immunoassay methodology.

30 whole blood samples were collected from consenting patients attending a state hospital in Liverpool, England. Hospital staff tested the samples, in duplicate, on each A1C analyzer. Samples were also sent to the European Reference Laboratory at Queen Beatrice Hospital in the Netherlands (a NGSP network laboratory) and were tested on the Primus CLC 385 (Primus Corporation).

Linear regression and bias plotting were used to assess accuracy. Precision, a measure of the degree of repeatability of an assay under normal operating conditions is expressed as the coefficient of variation of

the concentrations. Each sample was tested in duplicate and the coefficient of variation was calculated.

A bias summary of all four POCT A1C analyzers can quickly be seen using the Bland Altman graph. If the measurements are comparable, the differences should be small, centered around 0, and show no systematic variation with the mean of the measurement pairs.

Results

Results of linear regression are shown in the Table. Each method correlates highly with the reference method ($r = >0.97$), with the exception of the NycoCard ($r = 0.83$).

The Cholestech GDX and the DCA 2000 (Fig. 1 and 2) have 95% of values within the clinically significant $\pm 1\%$ of the expected A1C values (Primus). The A1cNow failed this criterion with 90% of its values within $\pm 1\%$ of the expected A1C values (Fig. 3). The NycoCard also failed with only 70% of its values within $\pm 1\%$ (Fig. 4).

All methods met the new, tighter criterion of $\leq 4\%$ CV set by the NGSP with the exception of the A1cNow, 5.2% CV (Table).

Discussion

NGSP has set stringent requirements for accuracy and precision; bias of 95% of values within $\pm 1\%$ of NGSP reference laboratory values and precision of $\leq 4\%$ CV (2002)².

The purpose of this multi-method study was to compare four NGSP-certified POCT A1C analyzers to determine the accuracy and precision of each one to the reference laboratory. This study has demonstrated acceptable accuracy and precision for A1C results measured using the Cholestech GDX and DCA 2000 analyzers. The A1cNow failed both criteria set by the NGSP for accuracy and precision. NycoCard was substantially inaccurate, with only 70% of its results within the $\pm 1\%$ criterion. The A1cNow and NycoCard data generated in this study did not meet the criteria for NGSP certification.

Table.

Analyzer	Correlation Coefficient	Linear Regression	% CV	% of values within $\pm 1\%$ of reference
NGSP certification requirement			$\leq 4\%$	95
Cholestech GDX	$r = 0.99$	$y = 1.02x - 0.1$	2.5	98
DCA 2000	$r = 0.99$	$y = 0.99x + 0.0$	3.1	100
A1cNow	$r = 0.97$	$y = 0.90x + 0.9$	5.2	90
NycoCard	$r = 0.83$	$y = 0.93x + 1.1$	0.6	70

Figure 1.

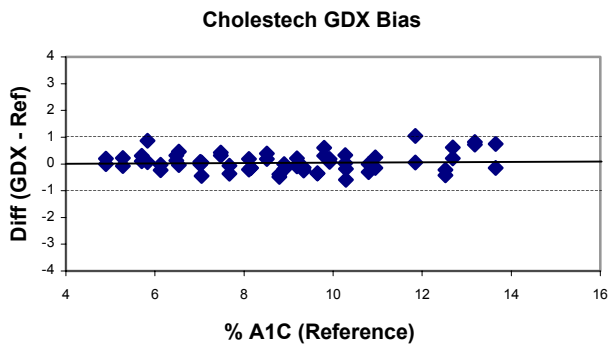


Figure 2.

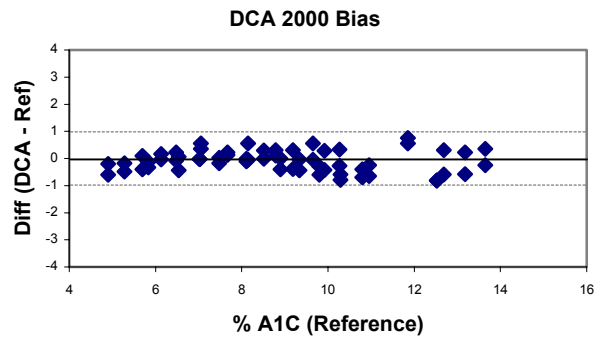


Figure 3.

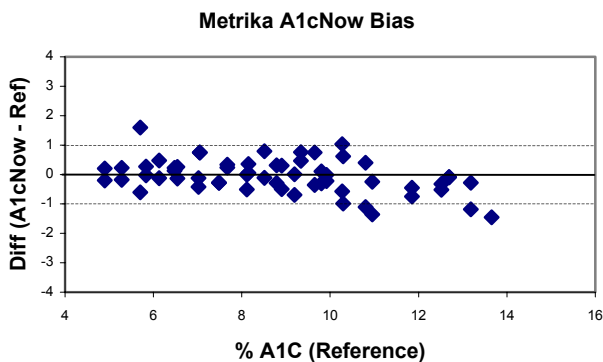
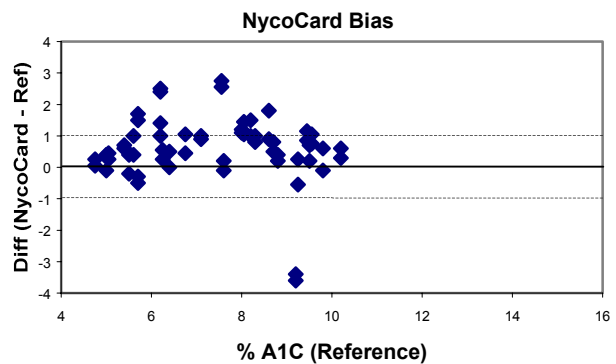


Figure 4.



References

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3. Little RR, Rohlfing CL, Wiedmeyer HM, Myers GL et al. The National Glycohemoglobin Standardization Program: a five-year progress report. *Clin Chem* 2001; 47:1985-92.