Discussion

GH-01, GH-02, GH-03, GH-04, and GH-05 specimens were prepared from pooled whole blood obtained from healthy or diabetic individuals. The target values were determined from the means of all results from nine National Glycohemoglobin Standardization Program (NGSP) Secondary Reference Laboratories (SRLs). Each laboratory analyzed each specimen in triplicate on two separate days. These NGSP Network Laboratories use methods that are calibrated and traceable to the method used in the Diabetes Control and Complications Trial (DCCT). Comparison to the NGSP Network allows both manufacturers and clinical laboratories to trace their glycated hemoglobin results to the DCCT. The target HbA$_{1c}$ values for the Survey are as follows: GH-01, 7.97%; GH-02, 5.89%; GH-03, 5.13%; GH-04, 7.40%; GH-05, 9.17%.

The Survey evaluates results against the NGSP reference method targets with an acceptable limit equal to ± 6% of the target value. Because the proficiency testing (PT) specimens are prepared from human whole blood, the bias observed for the PT specimens is expected to reliably reflect the bias that exists for patient specimens analyzed with the same method.[1] The percentage is a mathematical fraction, not the HbA$_{1c}$ reporting unit. For example, the acceptable range for GH-04, which has a HbA$_{1c}$ value of 7.40%, would be HbA$_{1c}$ values between 6.9 and 7.9%.

In addition to the 6% grading criterion used for HbA$_{1c}$, a second "dual grade" with an acceptable limit equal to ± 5% of the target value is shown on your laboratory evaluation. This second "dual grade" is provided for **educational purposes only** and is not reported to any laboratory accreditation agencies. Each laboratory must assess the accuracy and precision of its instrument, and if necessary, initiate appropriate actions.

For the five specimens, the pass rates vary considerably depending on the HbA$_{1c}$ method (data for all methods *n* ≥10 are summarized in Table 1). While the overall pass rate ranged from 97.0% to 98.3%, depending on the target value, some methods were able to achieve 100% (or close to 100%) pass rates for all five specimens.

Table 1

Specimen	NGSP Target (% HbA$_{1c}$)	Acceptable Range (+/- 6%)	Pass rate % (Low/High)	Cumulative Pass Rate %
GH-01	7.97	7.4 – 8.5	91.6/100.0	97.0
GH-02	5.89	5.5 – 6.3	94.1/100.0	98.3
GH-03	5.13	4.8 – 5.5	84.6/100.0	97.6
GH-04	7.40	6.9 – 7.9	93.3/100.0	97.9
GH-05	9.17	8.6 – 9.8	93.3/100.0	97.8

Pass rates listed are for methods with a peer group *n* ≥ 10.

Examination of the HbA$_{1c}$ results obtained by participants in the Survey reveals that in general the mean values measured by the participants did not differ markedly from the values determined by the NGSP Secondary Reference Laboratories. The method-specific means for GH-01 (HbA$_{1c}$ target value 7.97%) exhibited the least variation, ranging from 7.84% to 8.2% HbA$_{1c}$ (differences of -1.6 and +2.9%, respectively, from the target value). The method-specific means for GH-02 (HbA$_{1c}$ target value 5.89%) ranged from 5.68% to 6.07% HbA$_{1c}$ (these are differences of -3.8 and +3.1%, respectively, from the target value). GH-03 (HbA$_{1c}$ target value 5.3%) had method-specific means ranging from 4.92% to 5.28% HbA$_{1c}$ (differences of -4.1 and +2.9%, respectively, from the target value). GH-04 (HbA$_{1c}$ target value 7.40%) had method-specific means ranging from 7.15% to 7.58% HbA$_{1c}$ (differences of -3.4 and +2.4%, respectively, from the target value). GH-05 (HbA$_{1c}$ target value 9.17%) had

[1]EDTA in the PT specimens has been shown by the manufacturer of Bayer A1cNOW+ to cause artificially low results by this method. Routine patient specimens for this method are from fingerstick and do not include EDTA. The manufacturer recommends the use of heparin anticoagulant instead of EDTA when testing venous specimens. Peer group grading was employed for Bayer A1cNOW+ users.

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method-specific means ranging from 8.96% to 9.43% HbA_{1c} (differences of -2.3 and +2.8%, respectively, from the target value). Abbott Alinity ci series and Abbott Architect c System had CVs <1.5% for all five specimens. ARKRAY Adams HA-8180, Roche cobas c513, Sebia Capillarys 2 Flex Piercing and Tosoh G8 Automated HPLC had CVs ≤2.0% for all five specimens. Guidelines from The National Academy of Clinical Biochemistry and the American Diabetes Association recommend an inter-laboratory CV <3.5% (Clin Chem 2011; 57:e1-e47 and Diabetes Care 2011; 34:e61-99). Most methods were able to achieve this criterion. However, Siemens Dimension Vista had CVs ≥3.0% for three specimens and both Vitros 5,1 FS/4600/5600 Chemistry Systems and Siemens Atellica CH-Immunoassay reagent had CVs ≥3.0% for two specimens. Siemens Atellica CH-Enzymatic reagent had the lowest mean value for four specimens.

In addition to the tables, the data obtained for each method (with a peer group $n \geq 10$) are also presented in the style of box-and-whisker plots (Fig. 1). Each method is listed individually, with the number of participants using that method in parentheses after the name of the method. The individual lines extend from the minimum to maximum difference, expressed as a percentage from the target value (the percentage is a mathematical fraction). The thicker line indicates the distribution of the middle 90% of values. The grey shaded area represents the evaluation limit, ie, ± 6% from the target. The diamond is the median for the particular method. Outliers were excluded. The presentation allows rapid visualization of bias [how far the diamond (median) is from zero], imprecision (length of the line) and the number of laboratories that failed (those that lie outside the shaded area) for each method. This feature provides additional detailed information that should be useful to individual laboratories to assess their method and compare it to both their peers and to other methods.

Manufacturers of methods that have the means furthest from the reference value and those with the largest imprecision are encouraged to improve their performance, especially those methods that consistently exhibit large bias and/or large CVs. This is particularly important in the clinically relevant HbA_{1c} ranges (~5.5% to 8%).

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