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, 8.86%; GH-02, 6.84; GH-03, 9.39%; GH-04, 6.13%; and GH-05, 7.52%.

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. 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 6.13%, would be HbA_{1c} values between 5.7 and 6.5% (Table 1).

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 96% to 98.5%, 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	8.86	8.3 – 9.4	89.2/100.0	96.0
GH-02	6.84	6.4 – 7.3	89.2/100.0	98.5
GH-03	9.39	8.8 – 10.0	92.9/100.0	97.6
GH-04	6.13	5.7 – 6.5	90.0/100.0	98.4
GH-05	7.52	7.0 – 8.0	90.0/100.0	98.0

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-04 (HbA_{1c} target value 6.13%) exhibited the least variation, ranging from 5.91% to 6.19% HbA_{1c} (differences of -3.6 and +1.0%, respectively, from the target value). The method-specific means for GH-01 (HbA_{1c} target value 8.86%) ranged from 8.49% to 9.18% HbA_{1c} (these are differences of -4.1 and +3.6%, respectively, from the target value). GH-02 (HbA_{1c} target value 6.84%) had method-specific means ranging from 6.6% to 7.03% HbA_{1c} (differences of -3.5 and +2.8%, respectively, from the target value). GH-03 (HbA_{1c} target value 9.39%) had method-specific means ranging from 9.12% to 9.7% HbA_{1c} (differences of -2.9 and +2.8%, respectively, from the target value). GH-05 (HbA_{1c} target value 7.52%) had method-specific means ranging from 7.11% to 7.69% HbA_{1c} (differences of -5.5 and +2.3%, respectively, from the target value). Abbott Alinity ci series, Abbott Architect c System, ARKRAY Adams HA-8180 series, Roche cobas c513, Sebia Capillarys 3 (CAPI 3) Tera/Octa, Tosoh G8 Automated HPLC and Trinity Biotech Premier Hb9210 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

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Diabetes Care 2011; 34:e61-99). Almost all methods were able to achieve this criterion. Only Beckman AU HbA_{1c} Advanced (two specimens) and Roche COBAS Integra 400 (one specimen) had CVs ≥3.5%. Roche COBAS Integra 400 had CVs ≥3.0% for four specimens. Tosoh G8 Automated HPLC had the highest mean value for five specimens, while Siemens Dimension Vista 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, i.e., ± 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%).

David B. Sacks, MB, ChB, FRCPath
Clinical Chemistry Committee