Relative Inaccuracy of the A1cNow in Children With Type 1 Diabetes

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The Diabetes Control and Complications Trial (DCCT) confirmed the importance of tight glucose control in limiting the development of microvascular complications and established a standard for measuring A1C levels using high-performance liquid chromatography (HPLC) (1). Several studies demonstrated the benefit of rapid A1C testing in the clinic while face-to-face with the patient/family (2–4). The DCA2000 Analyzer (Bayer, Tarrytown, NY) uses an immunoassay method certified by the National Glycohemoglobin Standardization Program (NGSP) (5). It is frequently used to provide a rapid (6 min) A1C result, enhancing the ability to optimize therapy in a timely fashion. We recently reported that the DCA2000 was highly correlated with an HPLC reference (the DCCT standard) ($r = 0.94$, $P < 0.001$), although there was a slight bias with DCA2000 values being, on average, 0.2% higher than laboratory values (6).

The A1cNow (Metrika, Sunnyvale, CA) was developed as a single-use, disposable test for measuring A1C at home. It is small, about the size of a pager, requires one drop of blood, and uses an immunoassay. Results are displayed in ~8 min. However, there has been only one published study (7) to date assessing the accuracy of the A1cNow, and that study did not compare A1cNow values to the DCA2000. Furthermore, older generation A1cNow devices that were not NGSP certified were used in that study. We therefore designed the current study to compare the accuracy of updated, NGSP-certified A1cNow devices and corresponding DCA2000 levels with the DCCT/Epidemiology of Diabetes Interventions and Complications (EDIC) Study laboratory reference values when used at home and during a clinic visit in children with type 1 diabetes.

RESEARCH DESIGN AND METHODS

— The study was conducted at the five Diabetes Research in Children Network (DirecNet) clinical centers in 32 children with type 1 diabetes. Institutional review board approval and informed consent were obtained for the study. A1C was measured four times using the A1cNow, twice by the subject or parent at home and twice by site staff at a DirecNet study visit the same or the following day. Commercially available A1cNow monitors were used. Subjects were given the instructions provided by the manufacturer, with no additional instructions provided by clinical center staff. At the clinic visit, A1C was measured using the DCA2000, and a fingerstick blood sample was obtained, frozen at −70°C, and shipped to the DCCT/DirecNet Central Laboratory where measurements were performed using cation-exchange HPLC methodology (Tosoh) (1). At the same time that each A1cNow test was administered at home and in the clinic, the subjects' blood glucose concentration (reported in plasma equivalents) was measured using a Freestyle meter (Abbott Diabetes Care, Alameda, CA).

Least squares repeated-measures regression was used to compare the accuracy (absolute value of the difference between the device and laboratory A1C value) of the A1cNow versus DCA2000. Additional repeated-measures regressions were run to assess the impact of A1C (laboratory value) and glucose concentrations on A1cNow accuracy.

RESULTS

— The average age was 15 years; 41% were female and 94% Caucasian. The mean ± SD Central Laboratory A1C was 7.5 ± 0.9%, with 28% of values <7.0%, 41% between 7.0 and 7.9%, and 31% ≥8.0%. The DCA2000 was considerably more accurate than the A1cNow ($P < 0.001$). Thirty-two percent of the A1cNow values differed from the reference value by >0.5% compared with only 3% of the DCA2000 values (Table 1). There were no clinically significant differences in accuracy between subject/parent and staff measurements. Accuracy of the A1cNow did not vary with A1C level ($P = 0.22$); the A1cNow was within 0.5% in 74% of reference values ≥8.0% and 67% of reference values <8.0%. Glucose concentration at the time of the A1cNow also did not impact accuracy ($P = 0.18$). For the 25 cases in which two simultaneous A1cNow measurements were made at home and the 29 cases at the clinic, 32 and 34%, respectively, of the two measurements differed >0.5%. Scatterplots of the A1cNow and DCA2000 against the reference with the regression lines (Figure 1) also demonstrate a much tighter relationship with the DCA2000.

CONCLUSIONS

— The A1cNow is not as accurate as the DCA2000. A substantial proportion of measurements differ from a reference value >0.5%, whereas only 3% of DCA2000 values dif-

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Abbreviations: DCCT, Diabetes Control and Complications Trial; DirecNet, Diabetes Research in Children Network; HPLC, high-performance liquid chromatography; NGSP, National Glycohemoglobin Standardization Program.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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Table 1—*A1cNow and DCA2000 accuracy for 32 subjects*

Comparison	*n**	Median difference	Median absolute difference	Within ±0.1 (%)	Within ±0.3 (%)	Within ±0.5 (%)
DCA2000 vs. laboratory	32	+0.2	0.2	25	84	97
A1cNow (subject) vs. laboratory	55	0.0	0.4	15	42	69
A1cNow (staff) vs. laboratory	61	0.0	0.4	13	41	67
A1cNow (pooled) vs. laboratory	116	0.0	0.4	14	41	68
2 subject A1cNow values	25	NA	0.3	16	56	68
2 staff A1cNow values	29	NA	0.4	17	45	66

*Includes multiple pairs per subject. A1cNow value missing for nine subject measurements and three clinic staff measurements.

fered from the reference value >0.5%, which is consistent with our previous report (6).

Furthermore, and probably more importantly, there were marked differences in values when two simultaneous measurements were made, either at home by the parents or in the clinic setting by experienced clinical center staff. Thus, variability among simultaneous values does not appear to reflect errors in performing the tests by untrained parents and patients but instead reflects problems inherent to the A1cNow, even though the kits we used were NGSP certified. Our A1cNow results were consistent with those published by Kennedy and Herman (7). Using data from 6,231 subjects, they reported that 32% of values differed >0.75% from the laboratory reference (Bio-Rad Variant ion exchange) and that 20% were >1.0% discrepant. At present, the routine use of the A1cNow in children with type 1 diabetes cannot be recommended.

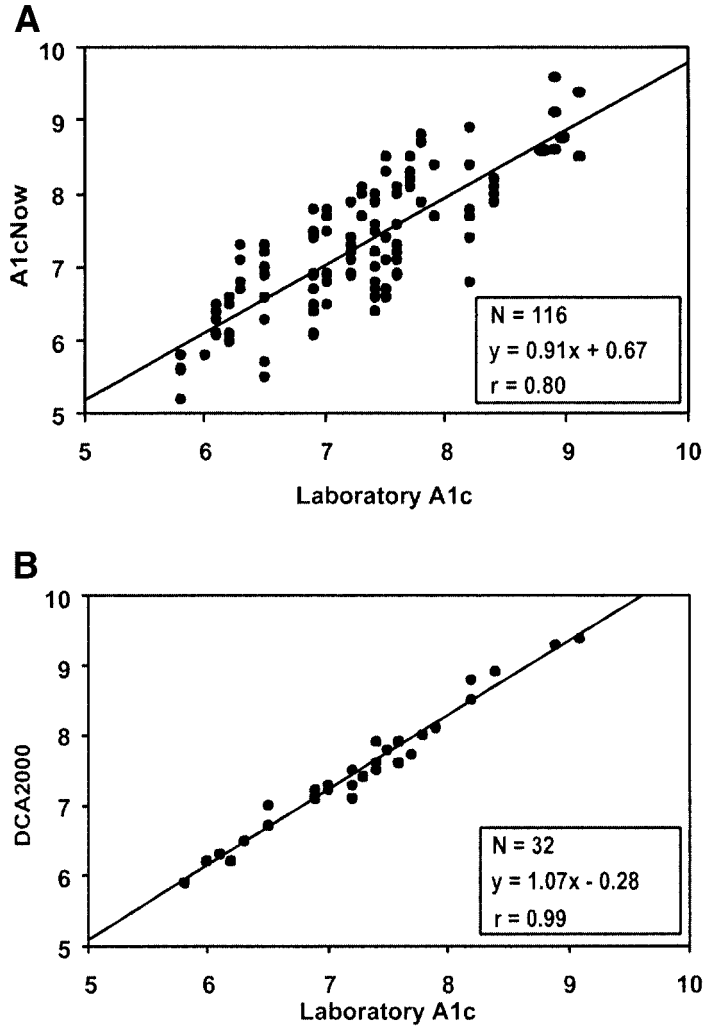

Figure 1— *Scatterplots of A1cNow* (A) *and DCA2000* (B) *versus laboratory reference. The regression line for A1cNow* (A) *accounts for repeated measurements per subject.*

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