Effect of Point-of-Care on Maintenance of Glycemic Control as Measured by A1C

JOHN R. PETERSEN, PHD[1]
JANE B. FINLEY, BS[2]
ANTHONY O. OKORODUDU, PHD[1]
AMIN A. MOHAMMAD, PHD[1]
JAMES J. GRADY, PHD[3]
MANDEEP BAJAJ, MD[4]

Although most diabetes management guidelines (1–3) suggest that physicians measure A1C, it is extremely difficult to have results available before a physician's evaluation of the patient. As such, point-of-care (POC) A1C is thought to be useful since it is assumed that rapid result availability will enhance diabetes care by increasing education and ensuring appropriate changes to therapy while the patient is being evaluated by a physician. This is indicated by a number of studies (4–7) that have found that POC was associated with a significant reduction in A1C. These studies, however, followed patients for <12 months, and the impact of POC A1C beyond the study period was not addressed. Recently, it was reported that the availability of POC A1C had no impact on the management of diabetic patients (8), and the lack of an effect could be explained by the fact that active treatment was based on achieving blood glucose rather than A1C targets or, possibly, the poor precision of the specific POC A1C method used (9). In 2001, the University of Texas Medical Branch opened the Stark Diabetes Center to give specialized diabetes care. After the 1st year, POC A1C testing was introduced, allowing us to conduct a cross-sectional retrospective study to determine what, if any, impact POC testing had on A1C levels over the subsequent 3.5 years.

RESEARCH DESIGN AND METHODS

— In a retrospective cross-sectional study approved by the institutional review board, we searched a laboratory database for patients who had diabetes, were aged >21 years, had documented A1C levels, and were treated in Stark Diabetes Center or the Family Medicine clinic from June 2001 through November 2005. The decision to measure A1C was determined by the attending physician. During the 1st year of Stark Diabetes Center's operation (June 2001–June 2002), A1C analysis was performed in the main pathology laboratory (HPLC, Variant II; Bio Rad, Hercules, CA). In June 2002, POC A1C (DCA 2000; Bayer HealthCare Diagnostic Division, Tarrytown, NY) was introduced in the Stark Diabetes Center. No POC A1C, however, was available in the Family Medicine clinic during the study, and all A1C analysis was performed by the main pathology laboratory.

The study was divided into nine 6-month time periods from June 2001 through November 2005. A total of 16,537 A1C results were analyzed over the study period. Of these, 9,550 results (2,535 patients) were from Stark Diabetes Center, and 6,987 results (2,003 patients) were from the Family Medicine clinic. A two-way, unpaired Student's *t* test was used to evaluate the changes in A1C values, χ^2 was used to determine the significance of differences in patient sex and race, and ordinary least-squares regression analysis was used to analyze the A1C levels adjusting for site, time, and patient demographics. A *P* value <0.05 was considered the criterion for statistical significance. SAS version 9.1 (SAS Institute, Cary, NC) was the statistical software used for the analysis.

RESULTS

— The average A1C for patients seen in Stark Diabetes Center at the start of the study (June 2001–November 2001) was significantly higher than for patients seen in the Family Medicine clinic (means ± SD 8.10 ± 1.78% vs. 7.81 ± 1.77%, respectively, $P = 0.003$) (Table 1). However, within 6 months, the average A1C for patients seen in Stark Diabetes Center significantly decreased ($P = 0.01$), becoming identical to that for patients in the Family Medicine clinic (7.91 ± 1.70% vs. 7.85 ± 1.94%, respectively, $P = 0.57$). During the 1st year (June 2002–June 2003) the POC A1C was available, the average A1C for the Stark Diabetes Center remained unchanged ($P > 0.46$). However, after 1 year of POC A1C availability (June 2003–November 2003), the average A1C in the Stark Diabetes Center showed a significant decrease compared with the previous 6 months (7.77 ± 1.48% to 7.62 ± 1.68%, $P = 0.025$). Although not significantly different from the Family Medicine clinic ($P = 0.072$), a trend toward a lower A1C value in the Stark Diabetes Center was apparent. In the next 6 months (December 2003–June 2004), the average A1C at the Stark Diabetes Center was significantly lower compared with that at the Family Medicine clinic (7.44 ± 1.54% vs. 7.85 ± 2.08%, respectively, $P < 0.0001$). This difference remained through the end of the study ($P < 0.0001$). Importantly, the average A1C for the Family Medicine clinic remained constant during the study ($P > 0.19$) when all time periods were compared with the average A1C at the start of the study. Since the population demographics for the two clinics were not identical ($P < 0.001$), we used a regression model to compare A1C levels across time (i.e., before and after June 2003) after adjusting for age, race, sex, and site (Stark Diabetes Center vs. Family Medicine clinic). The model indicated a strong time-by-site interaction ($P < 0.0001$). Bonferroni-adjusted comparisons (two-sided $\alpha = 0.05/6$) showed that after June 2003, the Stark Diabetes Center had significantly lower A1C levels than either the

From the [1]Department of Pathology, Medical Branch, University of Texas Medical Branch, Galveston, Texas; the [2]Department of Clinical Laboratory Science, University of Texas Medical Branch, Galveston, Texas; the [3]Department of Biostatistics, University of Texas Medical Branch, Galveston, Texas; and the [4]Department of Internal Medicine, University of Texas Medical Branch, Galveston, Texas.

Address correspondence and reprint requests to John R. Petersen, PhD, Department of Pathology, University of Texas Medical Branch, Galveston, TX 77555-0551. E-mail: jrpeters@utmb.edu.

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Abbreviations: POC, point-of-care.

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—*Levels of A1C, sex, age, and race for the Family Medicine clinic and the Stark Diabetes Center*

	June–November 2001	December 2001–May 2002	June–November 2002	December 2002–May 2003	June–November 2003	December 2003–May 2004	June–November 2004	December 2004–May 2005	June–November 2005
Family Medicine clinic									
A1C (%)	7.81 ± 1.77	7.85 ± 1.94*	7.75 ± 2.00*	7.83 ± 2.04*	7.77 ± 1.97*	7.85 ± 2.08*	7.91 ± 1.97*	7.75 ± 1.88*	7.69 ± 1.84*
Sex (%)									
Female	64.1	61.7	63.8	64.8	64.3	64.1	63.9	62.3	62.1
Male	35.9	38.3	36.2	35.2	35.7	35.9	36.1	37.7	37.9
Race (%)									
Caucasian	49.9	48.3	51.2	50.6	48.8	48.4	50.7	49.9	50.9
Black	31.2	31.8	29.7	30.2	29.4	31.7	29.5	31.9	29.6
Hispanic	18.4	18.2	18.6	17.9	20.9	18.1	19.0	15.6	17.2
Other	0.5	1.7	0.5	1.3	0.9	1.8	0.8	2.6	2.3
Age (years)	59.2 ± 13.0	58.4 ± 12.8	57.8 ± 12.9	57.9 ± 12.6	58.4 ± 12.5	58.7 ± 12.4	59.6 ± 12.7	60.1 ± 12.4	60.0 ± 12.5
n (total results)	652	724	694	786	793	854	788	844	852
n (total patients)	650	655	689	783	785	847	780	843	828
Samples per patient	1.00	1.11	1.01	1.00	1.01	1.01	1.01	1.00	1.03
Stark Diabetes Clinic									
A1C (%)	8.10 ± 1.78	7.91 ± 1.70	7.75 ± 1.72†	7.77 ± 1.48	7.62 ± 1.68	7.44 ± 1.54	7.35 ± 1.54	7.35 ± 1.55	7.41 ± 1.54
P value vs. Family Medicine clinic	0.003	0.53	0.98	0.67	0.072	<0.0001	<0.0001	<0.0001	<0.0001
Sex (%)									
Female	58.4	54.4	56.1	55.9	58.4	55.7	59.1	54.5	56.7
Male	41.6	45.6	43.9	44.1	41.6	44.3	40.9	45.5	43.4
Race (%)									
Caucasian	58.4	59.1	59.9	60.3	58.6	58.9	58.8	59.4	58.9
Black	23.8	23.7	20.7	23.8	24.1	24.9	25.4	23.6	23.9
Hispanic	15.0	16.5	16.2	14.8	14.9	14.3	13.3	15.8	15.9
Other	2.8	0.7	3.2	1.1	2.4	1.9	1.9	1.2	1.3
Age (years)	53.9 ± 15.0	55.6 ± 14.4	56.3 ± 14.9	57.3 ± 13.8	57.5 ± 13.6	58.1 ± 13.3	58.2 ± 13.6	58.8 ± 13.2	59.2 ± 13.4
n (total results)	698	846	844	969	1,105	1,198	1,224	1,372	1,294
n (total patients)	645	809	753	800	906	993	987	1,067	978
Samples per patient	1.08	1.05	1.12	1.21	1.22	1.21	1.24	1.28	1.32

Data are mean ± SD unless otherwise indicated. *$P > 0.19$ for differences in percent A1C compared with the first 6-month time period. †POC A1C initiated.

Family Medicine clinic (during both periods) or the Stark Diabetes Center (before June 2003). No other comparisons were significant.

CONCLUSIONS — Although a number of studies have shown a significant decrease in A1C for patients having immediate access to A1C (4–7), all were limited to study time periods of <12 months. While it is assumed that these differences will continue beyond the study time frame, no evidence is available to support this hypothesis. In this large, retrospective cross-sectional study, we have evidence that availability of POC A1C not only impacts the A1C in the short term (<1.5 years), but also in the longer term (currently 3.5 years).

We realize that there are limitations in this study. The fact that a clinic specializing in diabetes care was compared with a primary care clinic may have influenced the results of the study. Like the National Health and Examination Survey studies (9,10), both clinics had a similar percentage of patients with A1C <7% (42.9 vs. 44.1% for the Family Medicine clinic and Stark Diabetes Center, respectively, $P = 0.58$), meeting the American Diabetes Association guidelines at the end of the study period. However, the number of patients with A1C >8.0% was higher for the Family Medicine clinic versus the Stark Diabetes Center (33.6 vs. 26.5%, respectively, $P = 0.0006$) at the end of the study period, predisposing the patients at the Family Medicine clinic to a higher risk of complications. Thus, the present study shows that POC A1C can improve a patient's glycemic control by providing rapid, accurate, and reliable results. Since optimum care of diabetic patients is dependent on the interaction of the health care providers and the patient, providing POC A1C results should enhance this interaction by allowing immediate face-to-face counseling of patients.

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