Variation between Point-of-care and Laboratory HbA1c testing in Clinical Practice

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Objective: The aim of this study was to identify potential disparities between point-of-care testing (POCT) and laboratory hemoglobin A1c (HbA1c) reporting at a Federally Qualified Health Center (FQHC).

Methods: The electronic medical record was reviewed to identify POCT HbA1c done at a FQHC and centralized laboratory venous HbA1c performed on the same day. Manual data extraction was used to identify potential variables that could account for disparities between POCT and laboratory testing.

Results: A total of 42 samples in 40 patients were identified. The median HbA1c difference was 1.5 mmol/mol (0.15%) and ranged from -26 to 52 mmol/mol (-2.4 to 4.8%). Of the patients in the study, two had underlying comorbidities that could affect the POCT HbA1c.

Conclusion: Point-of-care HbA1c testing should not be used in solidarity to diagnosis pre-diabetes and diabetes. When using HbA1c results to guide therapy, self-monitoring of blood glucose and symptoms of both hypo- and hyperglycemia should be correlated to help determine appropriate therapy. [*P R Health Sci J 2019;38:189-191*]

Key words: Hemoglobin A1c, Laboratory, Point of care, Disparities

Hemoglobin A1c (HbA1c) is recommended for screening, diagnosis, and monitoring diabetes (1, 2). Point-of-care testing in the primary care setting has increased the number of documented HbA1cs in the patient medical record allowing providers to make preventative or therapeutic interventions (3). However, disparities between point-of-care testing (POCT) HbA1c and laboratory measurements in a controlled environment have been reported to be as high as 5 mmol/mol (0.4%) (4, 5). The impact of this may result in misdiagnosis and/or overly aggressive treatment increasing the risk for medication adverse effects. To our knowledge, our study is the first to examine the potential for variances in POCT and central venous testing in an actual practice environment. The American Diabetes Association recommends that if POCT is used for diagnostic purposes, the results should be confirmed by repeat testing unless the patient is experiencing overt signs of hyperglycemia (2).

Since implementation of POCT HbA1c in 2011 at our outpatient primary care facilities, several providers have reported disparities between POCT testing performed onsite and the central laboratory. The purpose of this study was to identify any HbA1c variances in a real world setting between POCT and laboratory testing.

Methods

Design

This is a retrospective review of the electronic medical record. Point-of-care HbA1c testing with DCA™ Vantage (Siemens Healthcare Diagnostics) began in May 2011. Reagent cartridges are stored and calibrated after each new lot number is received per manufacturer specifications. Three of our nine practice sites within our health system utilize onsite POCT HbA1c. Each utilizes the same equipment, policies and procedures to ensure ongoing quality control.

A report generated from the electronic medical record from May 2011 through May 2016 was created to identify patients who had both POCT and central laboratory venous HbA1c performed on the same day. Any patient that had a POCT HbA1c performed at one of the three locations that use onsite testing in our health system were eligible for inclusion. Results were excluded if both onsite and central laboratory tests were not performed on the same day. This study was granted approval by our Institutional Review Board.

Sample

Our health system provides a broad range of primary care health services to the area's inner city communities. Each site is made up of an interdisciplinary team of physicians and mid-level providers. Approximately 15% of the 750,000 residents in our county live below the poverty level. Additionally, our practice site provides care to a large number of refugee patients from several continents.

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Data collection and Analysis

Descriptive statistics were used to analyze the information gathered from the medical record. Point-of-care testing HbA1c results + 5 mmol/mol (0.5%) from centralized laboratory results are considered clinically significant differences based on previous publications (6). Patient records for these charts were reviewed manually by one of the authors to identify variables, hemolytic anemia, polycythemia, homozygous HbS, and HbC, which are known to influence POCT HbA1c testing (7). Evaluation of POCT technique in the pre- and post-analytic phases was not available.

Results

A total of 42 POCT HbA1cs were performed on the same day (Fig. 1). Fourteen samples showed a clinically significant difference of > 5 mmol/mol (0.5%) ranging from -26 to 52 mmol/mol (-2.4 to 4.8%) (Table 1). The median difference was 1.5 mmol/mol (0.15%). The most significant changes were observed in patients with HbA1c laboratory values above 86 mmol/mol (10%). Between the three different sites, the number of clinically significant differences for Site 1 was eight. For Sites 2 and 3 the number was four and two respectively. Site 1 receives roughly the same volume of patients as Sites 2 and 3 combined. Each clinically significant difference between discrete samples was performed at least one month apart. A total of seven different staff members performed the onsite testing that resulted in a clinically significant difference, two of whom were connected to two differences each. Information on staff members for five draws was not able to be determined due to inadequate documentation.

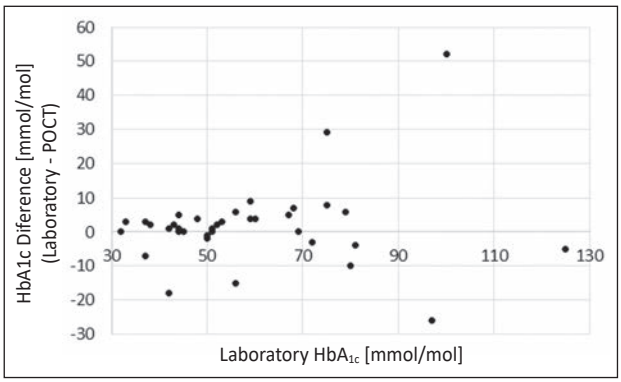

Figure 1. Recorded laboratory HbA_{1c} versus variance (laboratory – POCT) in POCT HbA_{1c}.

Two patients each had their blood drawn on the same day on two separate occasions and each instance is included as a discrete result. No variances from the four results in two patients resulted in a clinically significant different variance. A manual chart review resulted in two patients with underlying comorbidities that may affect point-of-care testing according to the HbA1c reagent cartridge package insert (7). Both had thalassemia, which can contribute to inaccurate POCT HbA1c. One patient did not have a clinically significant difference while the other resulted in a 7 mmol/mol (0.7%) difference, 37 and 44 mmol/mol (5.5 and 6.2%) for the central laboratory and point-of-care testing respectively.

Table 1. HbA1c Discrepancies

HbA1c Discrepancies ≥ 5 mmol/mol (%)	POCT HbA_{1c} mmol/mol (0.5%)	Laboratory HbA_{1c} mmol/mol (%)
-26 (-2.4)	123 (13.4)	97 (11)
-18 (-1.6)	60 (7.6)	42 (6)
-15 (-1.3)	71 (8.6)	56 (7.3)
-10 (-0.9)	90 (10.4)	80 (9.5)
-7 (-0.7)	44 (6.2)	37 (5.5)
5 (0.5)	39 (5.7)	44 (6.2)
5 (0.5)	62 (7.8)	67 (8.3)
6 (0.6)	73 (8.8)	79 (9.4)
6 (0.6)	50 (6.7)	56 (7.3)
8 (0.7)	67 (8.3)	75 (9)
7 (0.7)	61 (7.7)	68 (8.4)
9 (0.8)	50 (6.7)	59 (7.5)
29 (2.6)	46 (6.4)	75 (9)
52 (4.8)	38 (6.5)	100 (11.3)

Discussion

HbA1c testing in patients with diabetes is recommended quarterly for uncontrolled patients and at least annually for patients who are currently meeting their glycemic goals (1, 8). When POCT HbA1c testing is used for diagnostic purposes confirmation should be performed at a laboratory that is National Glycohemoglobin Standardization Program (NGSP) certified with standardized DCCT assays due to the potential for errors with POCT. In our study, POCT and laboratory testing occurred on the same day 42 times. The decision to perform both tests is not readily available as data was collected retrospectively. A majority of the patients already had confirmed diabetes and did not have a blood dyscrasia thus confirmatory testing was not indicated per guidelines and DCA™ Vantage specifications.

Laboratory errors are well documented in the literature and have the potential to result in significant patient harm (9). A majority of errors occur in the pre- and post-analytical phase (10). Point-of-care-testing may be particularly prone to errors relative to central laboratory testing due to less stringent performance criteria allowed for POCT. At our center, each site delegates quality assurance procedures to a licensed practical nurse who ensures consistency with policies, procedures, and manufacturer specifications. The licensed practical nurse (LPN) checks to make sure the equipment is in working order, HbA1c cartridges are in date, and appropriately calibrated for specific lot numbers. Quality assurance logbooks were reviewed to identify potential temporal relationship between machine maintenance, cartridge lot calibration, or any other issues that may have cause disparate results. None were identified. All LPNs as part of their onboarding process receive initial training on DCA™ Vantage

(Siemens Healthcare Diagnostics) POCT HbA1c machines and required to undergo an annual competency to maintain proficiency.

The DCA™ Vantage (Siemens Healthcare Diagnostics) POCT HbA1c machine is approved to accurately measure ranges between 4-130 mmol/mol (2.5-14%) (7). It does this by measuring total HbA1c concentrations in addition to total hemoglobin concentrations (%A1C = [A1C] / [Hgb] x 100). Factors that influence the lifespan of red blood cells (hemolytic anemia, thalassemia) can result in lower than expected HbA1c results while those that elevate it may falsely elevate values (11, 12). In one instance a patient's POCT HbA1c was substantially lower than the central laboratory result, 38 (6.5) mmol/mol versus 100 (11.3) mmol/mol, which could have resulted in a mis-diagnosis if not for confirmatory testing. A blood dyscrasia has the potential to lead to this type of variance but none were noted in the patient's past medical history. Two patients had thalassemia, and only one had a clinically significant difference between results. The POCT test was 0.7% higher, however, it cannot be explained by the underlying pathology as with a shorter red blood cell life span the HbA1c result should have been falsely low.

There were several limitations to our study. First, collection and processing technique of samples for HbA1c POCT was not available. This is significant as laboratory errors most often occur in the pre- and post-analytic phases with POCT. We reviewed the electronic medical record to identify staff performing tests who may be routinely associated with discrepancies. However, this data was incomplete preventing adequate analysis. Furthermore, numerous central laboratory sites were used as a comparator potentially influencing the variability in results. In addition, the impact on patient safety is unknown. Escalation or de-escalation of glycemic therapy and the direct impact on patients' blood glucose could not be correlated due to the retrospective nature of our study.

Conclusion

This study highlights the potential misleading POCT HbA1c results in the primary care setting. Several patient specific factors are known to influence testing but could not fully explain our discordant results. In a controlled setting, the DCA™ Vantage (Siemens Healthcare Diagnostics) displays a high degree of accuracy. The correlation coefficient between POCT and central laboratory values ranged from 0.97 to 0.98 in validation studies; onsite testing procedure may be the most likely reason for the different results noted in our study. Providers should correlate POCT HbA1c with clinical findings and home blood glucose testing when diagnosing and adjusting therapies for diabetes.

Resumen

Objetivo: El objetivo de este estudio fue identificar posibles diferencias en los resultados de hemoglobina glicosilada (HbA1c) obtenidos en los puntos de atención al paciente (POCT, por sus siglas en inglés) en un Centro de Salud Federalmente Calificado (FQHC, por los siglas en inglés), y aquellos reportados por un laboratorio. Métodos: Se revisaron los registros médicos electrónicos para identificar HbA1 c ejecutados hecho en los POCT de un FQHC y en un laboratorio centralizado, ambos procesados el mismo día. Se utilizó extracción manual de datos pará identificar posibles variables que podrían explicar las disparidades entre POCT y pruebas de laboratorio. Resultados: Se identificaron un total de 42 muestras pertenecientes a 40 pacientes. La diferencia en la mediana de HbA1 c fue 1.5 mmol/mol (0.15%) y osciló entre -26 a52 mmol/mol (-2.4 a 4.8%). De los pacientes en el estudio, dos tenían comorbilidades subyacentes que podrían haber afectado la POCT HbA1 c. Conclusión: No deberían utilizarse las pruebas de HbA1 c en los puntos de atención al paciente para diagnósticar pre-diabetes o diabetes. Cuando se usan los resultados de HbA1 c para guiar la terapia, auto- monitoreo de glucosa en la sangre y síntomas de hipo e hiperglicemia deberían correlacionarse para ayudar a determinar la terapia apropiada.

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