

Systematic Diabetes Screening Using Point-of-Care HbA_{1c} Testing Facilitates Identification of Prediabetes

Heather P. Whitley, PharmD, BCPS, CDE¹

Courtney Hanson, MBA²

Jason M. Parton, PhD²

¹Auburn University Harrison School of Pharmacy, Department of Pharmacy Practice Baptist Health System, Montgomery Family Medicine Residency Program, Montgomery, Alabama

²The University of Alabama, Culverhouse College of Commerce and Business Administration, Department of Information Systems, Statistics and Management Science, Tuscaloosa, Alabama



ABSTRACT

This prospective longitudinal study compares diabetes screenings between standard practices vs systematically offered point-of-care (POC) hemoglobin A_{1c} (HbA_{1c}) tests in patients aged 45 years or older. Systematically screened participants (n = 164) identified 63% (n = 104) with unknown hyperglycemia and 53% (n = 88) in prediabetes. The standard practice (n = 324) screened 22% (n = 73), most commonly by blood glucose (96%); 8% (n = 6) and 33% (n = 24) were found to have diabetes and prediabetes, respectively. The association between screening outcome and screening method was statistically significant ($P = 0.005$) in favor of HbA_{1c}. HbA_{1c} may be the most effective method to identify patients unknowingly living in hyperglycemia. Point-of-care tests further facilitate screening evaluation in a timely and feasible fashion.

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INTRODUCTION

Millions of Americans are unknowingly living with chronic hyperglycemia. Early identification through a reliable and convenient screening test may lead to prompt identification, intervention, and improved health outcomes.¹ Fasting blood glucose measured through a chemistry panel is inconvenient, highly variable, and delays care, unlike HbA_{1c} point-of-care (POC) tests. This investigates the population of adults 45 years of age and older for frequency of diabetes screening by standard practices vs a systematically offered HbA_{1c} POC test and determines differences in identifying unknown chronic hyperglycemia in a single-physician family medicine clinic.

METHODS

Patients with scheduled medical appointments on Tuesdays (active screening arm) and Wednesdays (standard practice arm) between April 2013 and March 2014 were evaluated by the clinical pharmacist. Patients' electronic medical records (EMR) were assessed for eligibility criteria: those aged 45 years or older were included; pregnancy, past medical history of diabetes (type 1 or type 2), HbA_{1c} test in the past 12 months, or steroid use (injectable or oral) in the past 3 months were exclusion criteria. Those meeting EMR criteria in the active screening arm were offered a free POC HbA_{1c} test by the clinical pharmacist during their scheduled medical appointment after verbally confirming eligibility.² The EMR of eligible "standard practice arm" patients was assessed for diabetes screenings under usual care. Study characteristics were examined with descriptive statistics; proportional differences were evaluated using a Pearson's χ^2 analysis of independence.

RESULTS

The standard practice arm evaluated 709 patients; however, 324 were included in final analysis per exclusion criteria. The active screening arm evaluated 689 patients. Exclusion criteria removed 390, and 117 were

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CORRESPONDING AUTHOR

Heather P. Whitley, PharmD, BCPS, CDE
Department of Pharmacy Practice
Baptist Health System, Montgomery Family
Medicine Residency Program
4371 Narrow Lane Rd, Suite #100
Montgomery, Alabama 36116
whitlhp@auburn.edu

unreachable due to logistics; 182 were offered participation, 17 declined, and 164 were screened. (Supplemental Appendix 1, <http://www.annfammed.org/content/15/2/162/suppl/DC1>.) Demographics were similar between the 2 study arms (Table 1). The majority was Caucasian (87%) and was comprised of more females (55%) than males. Age ranged from 45 to 91 (mean 63) years. They were predominately obese with an average height, weight, and BMI of 1.69 meters, 86.5 kg, and 31.0 kg/m², respectively.

In the active screening arm only 37% (n = 60) of patients had an HbA_{1c} ≤5.6%. Whereas 53% (n = 88) had an HbA_{1c} in the prediabetes range (5.7%-6.4%) and 10% (n = 16) of patients had an HbA_{1c} ≥6.5%. The average HbA_{1c} values for patients with euglycemia, prediabetes, and diabetes were 5.34%, 5.93%, and 6.68%, respectively.

The standard practice arm tested 73 (22%) patients, most commonly via blood glucose (n = 70, 96%). Only 4 individuals were screened by HbA_{1c} test; 1 of whom received both HbA_{1c} and blood glucose. Through this process, 33% (n = 24) were in the prediabetes glycemic

range, and 8% (n = 6) tested in the diabetes glycemic range. The majority was euglycemic (n = 43, 59%).

Glycemic outcomes were compared between the active and standard practices arms. The χ^2 analysis (Table 2) showed that the glycemic outcomes vs methods (active vs standard) were statistically different from one another ($P = 0.005$).

DISCUSSION

This study demonstrates that systematically screening adults (aged ≥45 years) for diabetes using a POC HbA_{1c} test, vs standard practices, greatly increases the chances for a screen to occur ($P = 0.005$). Outcomes show that 63% (n = 104) of patients systematically screened were unknowing living in chronic hyperglycemia compared to 41% (n = 30) under standard practices. Interestingly, the most profound impact was in ability to identify prediabetes (53% vs 33% respectively). Under standard practice, blood glucose was the most common screening method used (96%, n = 70), which was often captured as part of a larger

Table 1. Patient Demographics, Screening Practices, and Outcomes

Characteristic	Active Screening Arm (n = 164)			Active Screening Arm with USPSTF Criteria (n = 104)			Standard Practice Arm (n = 324)		
	N (%)	Mean	SD	N (%)	Mean	SD	N (%)	Mean	SD
Age (years)		63.5	10.28		58.5	6.69		63.3	11.71
BMI (kg/m ²)		31.0	7.08		33.9	6.83		29.3	7.08
Morbidly obese (BMI >40)	16 (10)	46.3	5.13	16 (15)	46.3	5.13	30 (9)	44.1	4.24
Obese (BMI 30-40)	60 (37)	34.2	2.69	51 (49)	34.6	2.72	94 (29)	34.2	2.67
Overweight (BMI 25-29)	58 (35)	27.5	1.46	37 (36)	27.6	1.45	106 (33)	27.2	1.39
Healthy weight (BMI 18.5-25)	28 (17)	22.5	2.16	–	–	–	91 (28)	21.9	2.21
Did not report	2 (1)	–	–	–	–	–	3 (1)	–	–
Race/Ethnicity									
African American	12 (7)			9 (9)			27 (8)		
Caucasian	142 (87)			87 (84)			285 (88)		
Other/did not report	10 (6)			8 (8)			12 (4)		
Sex									
Female	91 (55)			57 (55)			209 (65)		
Male	73 (45)			47 (45)			113 (35)		
Possesses health insurance	155 (95)			97 (94)			302 (93)		
Screening practices									
Eligible and screened	164 (100)			104 (100)			73 (23)		
Eligible but not screened	0 (0)			0 (0)			251 (77)		
Screening method									
A _{1c}	164 (100)	5.80	0.51	104 (100)	5.78	0.54	4 (5)	6.08	0.64
Blood glucose	0 (0)			0 (0)			70 (96)	103.11	23.26
Screening outcome									
Diabetes	16 (10)	6.68	0.19	10 (10)	7.00	0.53	6 (8)		
Prediabetes	88 (53)	5.93	0.47	52 (50)	5.91	0.19	24 (33)		
Euglycemic	60 (37)	5.34	0.23	42 (40)	5.33	0.23	43 (59)		

USPSTF = United States Preventive Services Task Force; BMI = body mass index.

Table 2. Comparative Analysis of Standard Practice Arm to Active Screening Arm

Screening Outcome	Screening Practice	
	Active Screening, N (%)	Standard Practice, N (%)
Diabetes	16 (10)	6 (8)
Prediabetes	88 (53)	24 (33)
Euglycemic	60 (37)	43 (59)

χ^2 10.53, df 2, P = 0.005

venipuncture chemistry panel. The 22% difference in hyperglycemic detectability between screening arms is best explained by test utility.

HbA_{1c} is durable and more accurately reflects sustained hyperglycemia over a 3-month period as compared to fasting or random glucose. Diagnosis by glucose alone may initially be missed until the glycemic curve fully shifts upward, crosses the diagnostic threshold, and bothersome symptoms develop, impacting daily life. Therefore, HbA_{1c} may be a superior screening method,³ due to effectively identifying individuals early on in the course of the disease, which accounts for this study's difference in identified hyperglycemia. Furthermore, POC HbA_{1c} devices improve patient care by allowing for immediate assessment, patient education, and early management initiated by the practitioner.⁴⁻⁶ Identifying and treating chronic hyperglycemia early can result in clinically meaningful patient outcomes, which is most feasible by HbA_{1c} screenings and further facilitated by POC devices.

The American Diabetes Association recommends screening adults aged ≥ 45 years or those younger with at least 1 risk factor.¹ Conversely, United States Preventative Services Task Force (USPSTF) recommendations focus on overweight or obese patients aged 40 to 70 years.⁷ Post-hoc analysis applying USPSTF recommendations reduced screenings from 164 to 104 patients, with similar results: average HbA_{1c} 5.78%, 10% HbA_{1c} $\geq 6.5\%$, and 50% HbA_{1c} 5.7%-6.4%, but resulted in a higher average HbA_{1c} for outcomes $\geq 6.5\%$ vs ADA criteria. (Table 1) Tighter USPSTF screening parameters, however, missed identifying 36 patients with HbA_{1c} 5.7%-6.4% and 6 with HbA_{1c} $\geq 6.5\%$. Regardless of guidelines used, the post-hoc analysis shows that systematically screening patients is more effective than standard screening practices.

Limitations

While this investigation effectively articulated the frequency of diabetes screenings conducted under standard practice compared to a systematic approach and the outcomes of those screenings, it did not inves-

tigate what prompted or prevented the clinicians from screening patients. Future research should focus on (1) how to improve screening programs for chronic hyperglycemia, (2) methods to facilitate patients' medical and personal behaviors to safely, effectively, and efficiently lower their glycemic curve, and (3) benefits of these screening and health initiatives on outcomes, including reductions in microvascular complications, economic cost impact, and change in quality of life.

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Key words: diabetes; prediabetes; screening; hemoglobin A_{1c}; HbA_{1c}

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